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NORTHEASTERN FOREST
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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

FOREST RESEARCH
ACTIVITIES

FOREST MANAGEMENT
RANGE MANAGEMENT
FOREST PRODUCTS

FOREST ECONOMICS
FOREST SURVEY
FOREST INFLUENCES

APR 1939



FOREST RESEARCH
BI-MONTHLY REPORT

April 1, 1939

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GENERAL

Allegheny

Personnel. The death on January 14 of Senior Ranger P. E. Ackerman who had been in charge of the Kane Experimental Forest since its establishment in 1932, has been a real blow to the Station and the staff. Resourceful, energetic, and popular with everyone who knew him, Ackerman made an enduring contribution to Station progress.

Dr. C. H. Diebold transferred from the Rocky Mountain Station to the Allegheny to assume charge of the Forest Service contingent on the Youghiogheny Flood Control Survey.

Advisory Council. A successful and well-attended meeting of the Allegheny Forest Research Advisory Council was held at the Morris Arboretum. The work of the Allegheny Station was briefly reported by Director Forbes and Doctor Jackson, and the work of other research agencies by representatives of the State forestry departments, the Pennsylvania State College, and the Armstrong Forest Company. Several Council members made a vigorous plea to Assistant Chief C. L. Forsling, who attended the meeting, in favor of high priority for Allegheny Station items in future budget recommendations. A committee was appointed to follow this matter through.

Cooperation. A WPA project at the University of Pennsylvania mounted and labeled 354 herbarium specimens collected by the staff over a period of years. A statement in some detail was furnished by us to the Botany Department of the University describing botanical or ecological studies which might be profitable undertaken by graduate students at our Lebanon branch. A graduate student in economics, interested in municipal and community forests, has been working in our library and with our help has aroused considerable interest in forest economics in the Wharton School.

Appalachian

Meetings. Jemison presented a paper on "Forest Fire Danger Measurement and Its Application to Fire Prevention and Control in the Eastern United States" before the Appalachian Section of the Society of American Foresters, and addressed forestry school students at Duke University and North Carolina State College on the subject of "Forest Pyrology."

Hawes spoke to the Forestry Club at Duke University, on "Experimental pulpwood cuttings in second-growth loblolly pine," with special reference to the Duke plots.

McArdle delivered an address on "New and renewed impressions of the South", before the Appalachian Section of the Society of American Forests. He spoke also to the farmers of West Virginia and to a conservation class at Western State Teachers College. Talks on forest research were made to forestry students at North Carolina State College, Duke University, and the University of West Virginia.

Central States

Meetings. Three papers were given by Staff members at the University of Missouri, Short Course. Lotti presented Knight's paper, "Flood Control and Its Problems." Liming spoke on "Composition, Condition and Growth Rate of the Reproduction in the Repeatedly Burned Missouri Ozarks," and Auten discussed the appraisal of site qualities of farm-woods in "The Forest Soil Profile; its Growth, Destruction, and Rebuilding from Abandonment."

On February 6 Auten lectured at Ohio State University in connection with the "Educational Meetings for Soil Conservation Service Technicians and Labor Foremen in the Mt. Vernon District and Camp Counties." His subject was "The Value of Sassafras, Black Locust, and Pine in Rebuilding the Forest Soil Profile."

On February 16-17, the Station held an informal investigative meeting with the Regional Forester's Office at Milwaukee, Wisconsin. Supervisors of the southern forests or their Assistants, Regional Office Branch Heads, A. Koehler and J. B. Cuno from the Laboratory, and R. E. Marsh from Washington, D. C. were in attendance besides Day, Auten, Chapman, Liming, Kellogg, Kelly, Kuenzel and Worthington from the Station.

On February 27 Auten lectured before the Plant Institute of Ohio State University on "The Properties of the Virgin Forest Soil Profile; Their Changes by Fire, Grazing, and Cultivation and Their Return to Equilibrium Under Various Vegetative Covers."

Intermountain

Personnel. Mr. Arthur Roth, a graduate of the University of Minnesota and Montana State College at Bozeman, has recently been appointed as Assistant Economist on the Intermountain staff. He will be associated with Mr. Mont H. Saunderson who heads up the newly created division of Economics research in the Intermountain Forest and Range Experiment Station.

Lake States

Meetings. Cunningham attended the annual meeting of the Michigan Academy of Science at Ann Arbor March 17-18 and spoke on the subject of "Research Needed in the Farm Woods."

Bates presented papers on : "Frost, Snow, and Frozen Ground in Relation to Infiltration," "Measuring the Amount of Eroded Material by Silt Sampling," and "The Bed Load of Streams," before the meetings held at the the San Dimas Experimental Forest February 12-27.

Northeastern

Personnel. The Station regrets the loss of Dr. A. P. Jacot who died March 24 after but a few days illness. Dr. Jacot had spent some ten or eleven years in China as head of the Department of Biology in Standard University. Coming back to this country, he entered Cornell University obtaining his doctor's degree in 1933. Accepting temporary employment at the Appalachian Station in 1935, he transferred to the Northeastern Station in 1937 as Associate Conservationist. Jacot's special field of study was soil fauna, particularly the microarthropods, and the part they play in the reduction of forest floor litter.

Pacific Northwest

Personnel. Junior Forester Loyd Bransford, who for the past year has acted most competently as resident officer at the Wind River Experimental Forest, transfers to a permanent place in the Soil Conservation Service April 1. His going is a distinct loss to this organization. His place has been filled by the transfer from the Olympic National Forest of Junior Forester Roger N. Young.

Meetings. Early in March Cowlin addressed the Portland Wholesale Lumbermen's Club on the work of the forest survey. Considerable interest was shown in the progress and results of the work in other regions, particularly the South.

FOREST ECONOMICS

FOREST SURVEY

Appalachian

Depletion

Approximately 800 returns for the North Carolina 1938 census of lumber production have been received and edited by the Survey staff. This is about one-fourth of the 3220 forms sent out to saw-mill operators by the Bureau of the Census. Although additional returns will doubtless be received when the third notice is sent to delinquent operators, the total will probably not exceed 1200 returns. This indicates the necessity for an intensive field check in order to obtain an accurate census of lumber production for the year.

Reports

The final draft of the unit release of the northern Coastal Plain of South Carolina (S. C. #2) has been sent to the Washington office, to Region 8, and to the State Forester for review prior to publication. The releases for the other two units in South Carolina are being reviewed and checked.

An unusually large number of requests for Survey data have been received from government agencies and from industries during the last 2 months. Requests from industrial organizations indicate a growing appreciation of the value of Survey information by private agencies.

Lake States

Keeping Inventory Current

The Lake States Station, in common with the Southern and Appalachian Forest Experiment Stations, has this year entered into an agreement with the U. S. Census to cooperate in collection of lumber production from sawmills as one important item of drain on the forest resource. Similar cooperative arrangements have been in force in the West for a number of years, but because of the problem of obtaining reports from the great number of small sawmills in the East, it seemed wise to start in only one State in the region on a trial basis.

Wisconsin was selected because the Forest Survey of the State had just been completed thereby furnishing the most recent and complete information available on number and production of sawmills.

The Forest Survey canvass of sawmills, which was made during 1937 and early 1938, disclosed 1,538 sawmills, of which 702 average more than 50 thousand board feet annual production, the approximate lower limit of coverage set by the U. S. Census. In contrast, the Census list of mills included only 280 names and in 1936 only 261 mills were reported operating. In 1937, a year of greater sawmill activity, only 217 sawmills were reported by the Census for Wisconsin.

A rough comparison of Census and Forest Survey figures for 1936 shows that the 1,277 mills not recorded by the Census account for 26.5 percent of total Wisconsin lumber production, of which 2.7 percent is the output of the smallest mills, cutting less than 50 thousand board feet annually. From the standpoint of State totals, the output of the smallest mills does not appear to be very important. However, in areas of farm woods the small farmer-owned mills have considerable bearing on the present condition of the woods. The next class of small mills, those cutting between 50 thousand and 500 thousand feet annually, which did not report to the U. S. Census, number 440, and account for nearly one-fourth of the lumber produced in Wisconsin.

With the help of Forest Survey lists, the Census has now added 465 new names, making a total of 745 mill addresses for Wisconsin. Schedules are now being returned through the Lake States Station. So far (March 21, 1939), 432 mills or 58 percent have reported. At this stage it is difficult to say how many of the 50-thousand-to-500-thousand class of mills will report without a field contact, for many of the portable mills move so frequently that it is impossible to keep a miling list up to date; but in any case the accuracy of the Census reports is going to be materially improved and the Forest Survey job of keeping the Forest Survey up to date will be expedited.

Northern Rocky Mountain

Inventory

The northern Rocky Mountain region for the past 40 years has been recognized as one of the most important cedar producing areas in the United States. Up until about 1930 this area supplied about 60 percent of the total western red cedar poles produced. However, we who live here and are most vitally concerned are most likely to overlook its national importance because the cedar pole industry is so closely associated with and in many instances dependent upon white pine sawtimber operations. During 1937-38, Commings and Varney conducted a thoroughgoing study of the cedar pole resource. The results of this study are in the process of publication and will soon be available for distribution by the experiment station.

It is estimated roughly that annual production since about 1906 has averaged approximately 400,000 poles per year with an annual revenue of about \$1,500,000 furnishing employment to several thousand men each year. The period of greatest production occurred from 1910-28 during which annual cut often exceeded 500,000. The lowest production on record was in 1933 with a cut of less than 20,000 poles.

With present annual drain far exceeding growth, and the present supply rapidly diminishing, the future presents an alarming situation. For example, it is estimated that during the next 20 years approximately 600 poles will be cut for every 100 attaining pole size through growth. On the basis of this relationship, present supplies plus growth are expected to last only 22 to 25 years, after which this region will enter into a 20- to 40-year period of low production.

The remaining supply of cedar poles on sawtimber areas in northeastern Washington and North Idaho is estimated to be 7,260,000 pieces. It is estimated that growth during the next 20 years will be 1,139,000 poles. Future drain for the same period based on present trends is expected to approximate 7,200,000 poles or 360,000 annually.

One of the redeeming features which tends to ease the situation is the productive capacity of the region due to the presence of large areas of potential cedar-producing forests. If these stands were managed so as to produce eight poles at 120 years (the average yield of present stands) an annual cut of 186,000 poles could be maintained. It is interesting to note that in the Capper Report of 1920 average annual growth for the same rotation period was estimated to be 110,000 poles.

If the present supply, plus growth, can be made to last 45 to 50 years, it is estimated that an average annual cut of 200,000 poles which is equal approximately to the productive capacity of the region can be maintained with no lapse in production.

Requirements

In the requirements report completed during the month of March, it is revealed that the total annual consumption of all timber products in the northern Rocky Mountain region approximates 1,155,516,000 board feet (log scale). Almost 55 percent of this consumption is fuelwood; however, more than half of the fuelwood is from dead timber. Lumber represents the principal green timber product utilized in the region, the total amount equaling 416 million board feet log scale, or 514 million board feet lumber tally. On a lumber tally basis the

the consumption amounts to 616 board feet per capita. The per capita consumption varies considerably from place to place in the region, ranging from 312 board feet in the eastern part of Montana to 1,097 board feet in northeastern Washington. The box, match block, and millwork plants concentrated principally in northern Idaho and northeastern Washington account for 46 percent of the lumber used, or 281 board feet per person. The railroads, farms, and mines rank next in that order, as is shown in the following tabulation:

Per capita consumption of sawed timber products
by type of consumption, board feet, lumber tally,
northern Rocky Mountain region.

Remanufacturing industries	281
Railroads	100
Farms	88
Mining industry	71
State and county highways	21
Power and communication systems	2
Federal agencies	5
Urban building and municipal governments	40
Rural nonfarm building	8
Total	616

Pacific Northwest

Inventory

By bringing the inventory up to date it is shown that in spite of saw-timber depletion at the rate of a quarter billion board feet a year, Pacific County still has over 11 billion board feet of highly accessible saw timber. The majority of this timber volume, however, is in the pulp species. Over 60 percent of the forest land supports saw-timber stands, and 23 percent is occupied by stands of less than saw-timber size, mostly in the 10-year age class. The deforested area is not as large as in many other counties.

Reports

Rough drafts of the forest growth and depletion sections of the regional report have been completed and excellent progress is being made on the analysis of the adequacy of saw-timber supplies to maintain the regional economy.

In the growth phase of the survey information was obtained regarding the structure of virgin ponderosa pine stands. This information on the proportion of the various age and vigor classes

in the stands enabled a closer estimate of their growth potentialities, of their mortality risk, and of their value. Although this study showed a preponderance of the mature and overmature tree classes throughout the region, there are fairly wide variations from the regional average within the various counties. For example, over the region as a whole 14 percent of the saw-timber volume in the pure pine type is in the immature tree classes, 17 percent is in the thrifty mature class, and 69 percent of the volume is classed as mature and overmature. However, the pure pine stands of Umatilla, Morrow, and Wheeler Counties, Oregon, are materially less thrifty than the regional average, over 80 percent of their volume being contained in the mature and overmature tree classes. In contrast is Ferry County, Washington, where only 55 percent of the volume is in the mature and overmature group, 30 percent being in the immature class, and 15 percent in the thrifty mature.

Southern

Reports

Miscellaneous Publication No. 326, "Forest Resources of Southeastern Texas," was published by the Government Printing Office. Southeastern Texas has some of the fastest growing stands in the United States. Average increment per acre for the entire forest area (including reproduction, clearcut, and fire killed) amounted to 195 board feet; or, for all growing stock in trees 5 inches d.b.h. and larger, almost two-thirds of a cord.

NEW PUBLIC DOMAIN

Pacific Northwest

The Land Economics section cooperated with the Regional Office and others in examining several measures proposed for and introduced at the 1939 regular legislative assemblies of Oregon and Washington which terminated in March. Some of these bear directly upon the New Public Domain.

The Oregon assembly enacted into law House Bill 517 which permits the State to (1) take over tax-forfeited and other lands from the counties upon their consent, (2) manage and enter into agreements with the Federal Government for the management of these lands for forest purposes including grazing, and (3) pay over to the counties the net returns from these lands after deducting from gross returns State

costs and 10 percent for a State forest fund. This measure facilitates State exercise of Fulmer Act privileges formerly exercisable only by the counties.

The Washington assembly enacted into law Senate Bill 456 authorizing the cooperative management of State forest board lands and State granted lands with national forests and private timber lands in sustained yield forest management units. Careful operation under this law may hurdle some of the checkerboard ownership obstacles to stable tenure and long-term management.

The rural zoning measure for Oregon, drafted by private individuals with the joint cooperation of this Station and the Bureau of Agricultural Economics, was not introduced because local support was believed insufficient. Oregon Senate Bill 376, requiring the counties to sell tax-forfeited lands to the owner of record prior to foreclosure or his assigns upon demand at any time, fortunately did not pass. A measure to extend the tax delinquency period allowable before tax foreclosure of certain lands and to waive interest and penalties thereon passed both Oregon houses but was vetoed by the Governor. The measure was objected to because it would penalize those who paid their taxes promptly, encourage tax delinquency and unnecessarily liberalize the existent lenient tax delinquency laws.

Cooperation continued with State agencies and the Bureau of Agricultural Economics on land classification in Oregon and Washington. Separation of forest from grazing lands continues to be a serious problem in the Douglas fir region because of wide-spread local pressure for conversion of cut-over lands to grass and the lack of criteria upon which to base the separation. Cooperation with the Regional Planning Commission was in connection with the problem of the Dust Bowl migrant on stump lands and with the Land Resources program for the annual conference to be held in Seattle April 27-29.

The month of March witnessed the end of the legislative sessions in both Oregon and Washington without the enactment of any laws tending to solve the forest tax problem. The Regional Office and Experiment Station reached a formal agreement on the attitude to be taken toward pending forest tax measures, i.e., favoring a Washington deferred timber tax measure and an Oregon measure which would provide for the State assessment of forest property. The legislatures were apparently unable to distinguish between measures designed to affect particular forest owners and those having to do with conservation in the broad public interest, therefore no important action was taken. The Service was not asked to take an active position in regard to any proposed forest tax legislation.

The Stevens County local government adaptation study was continued. With WPA assistance plats and maps were prepared for the entire county showing assessed values and lands in the different categories of public ownership.

Southern

Analysis of a new project in taxation and tax delinquency of forest land in all parts of the Gulf States was begun in February. The purpose of the new project is to obtain data over a series of years on the average tax per acre on forest land (and timber) in each of three condition-classes in each major forest type-group in each State of the Station's territory, from which a series of tax index numbers can be derived. Preliminary analysis indicates that the three condition-classes recognized should follow the following classifications (adapted from those used in the Southern Forest Survey): (1) old-growth, uncut and partly cut; (2) second-growth, sawlog size, uncut and partly cut; and (3) balance of forest land, including second-growth under sawlog size, reproduction, and clear-cut. Sample properties will be classified as pine, hardwood, or cypress type.

Methods of sampling are being studied to arrive at a statistically sound basis which, at the same time, will be within the availability of time and funds for the study. One approach now being given serious consideration is based on an intensive study of one easily determined factor of the tax, namely, tax rates, in each county of a given unit (corresponding to a major type-group in one State), and an extensive determination of the other factor, assessed values, on sample properties in a relatively few counties. The average tax determined from the extensive coverage can then be corrected, for a given unit, by statistical methods from the data on rates determined from the intensive coverage.

Following a decision on sampling technique, field work will be started in one unit to determine the feasibility and accuracy of this sampling method. This unit will probably be the longleaf-slash pine area of southern Mississippi.

PRIVATE FORESTRY

Central States

Farm Woodlands

The progress report on the farm woodlands inquiry in northwestern Ohio began to assume shape during this two-month period. The charts and figures for the report were listed and designed for final drafting, photostat copies being made for a temporary record. Stand structure diagrams following the "Swiss" system as exemplified by Kirkland in Occasional Paper No. 70 of the Southern Station and in his "Selective Timber Management in the Douglas Fir Region," (Brandstrom, co-author) are the basis for the present charts. Ten of these are to be prepared depicting farm woodland conditions in three northwestern townships according to the economic woodland classification designed in the present investigation.

A week was spent in Washington going over the past work, present status, and plans for the project in 1939.

During the spring recess three students from the Bureau of Business Research of Ohio State University were hired for temporary work in rounding out the analysis. A most interesting phase of their work was the analysis of the quadrat-sampling of seedlings and saplings (of sawlog species less than five inches in diameter). From preliminary indications, it appears that an adequate supply of seedlings and saplings is being maintained in some woodlands even under grazing classed as medium in intensity.

The last week in the month was spent largely at the University of Illinois. At the Farmers Institute, held at Purdue University, aid was obtained from R. C. Brundage for specifications in current use on sizes and growth rates for high quality hardwood stumpage and partially processed forest products such as billets and sawlogs. A chart is to be prepared depicting the physical characteristics as to size and growth rate in relation to market demand. Again an economic classification has been devised (high, medium, and low quality categories) which ties closely with the size classes of the stand structure diagrams (these being poles - 5 to 12.9 inches, d.b.h.; small timber, 13 to 20.9 inches, d.b.h.; medium timber, 21 to 31.9 inches, d.b.h.; large timber, over 31.9 inches, d.b.h.). It appears that such a chart based on value and closely associated with the stand structure diagrams will provide a sound basis to advocate light and frequent cuttings and the maintenance of a heavy growing stock with an ample

distribution of timber in the large, high-quality categories. Brundage's stumpage and sawlog prices for northern Indiana were found to agree very closely with the ones obtained in northwestern Ohio.

Northern Rocky Mountain

Financial Aspects

Cost of Lumber Manufacture in 1938. According to a recently completed canvass of about 30 of the larger band sawmills of the Inland Empire, lumber manufacturing costs for 1938 were from 5 to 15 percent higher than for 1937. The increase was due to a 30 percent reduction in production, which increased fixed annual costs when computed on a basis of cost per thousand feet of production. Social security (old age pensions and unemployment insurance) obligations are also responsible for part of the increased cost. As an example, these items amounted to 77 cents per M for one large white pine operation in Idaho based on the stump-to-finished-lumber cost. Since this cost is based upon a percentage of the payroll, it can be reduced by displacement of manpower by machines. As the social security and labor costs increase, and they are scheduled to increase, operators will undoubtedly attempt to replace men with machines. The social security cost of logging only, for one of our most machine-minded loggers was 22 cents per M, contrasted with 38 cents per M for another large operator who follows horse logging, in which a greater proportion of manpower is employed. Minimum wages are 60 cents per hour in most of the white pine sawmills of the region and 50 cents per hour in the ponderosa pine and larch-Douglas fir mills.

Pacific Northwest

Financial Aspects

Considerable time and thought has been given by Brandstrom to the selective logging study which the Weyerhaeuser Timber Company has started on a 1,500-acre area near Mineral, Washington--a study in which Brandstrom is to function as a consultant to the company and as a "clearing house" for Forest Service participation in the study. A detailed inventory of the study area has already been completed in which all trees 26 inches in d.b.h. and larger have been tagged, numbered, and log graded. The log grading system used in this study, which was worked out by one of the company's own men, features nine different grades based primarily upon surface appearance so that they can readily be identified in the standing trees.

The next major step in the study will be to do the actual marking for the initial cut, which Brandstrom has recommended be fixed at 30 percent of the total volume of live standing timber plus whatever volume may be obtained from dead and down timber and from such group-wise clear-cutting operations as may be decided upon later. Actual logging will probably not be started until late this fall but in the meantime a great deal of study work will be carried on. Brandstrom's ideas and suggestions with regard to both study procedure and study objectives have recently been submitted to the company in the form of a lengthy memorandum.

Southern

Financial Aspects

Substantial savings in costs ranging from one-fourth to one-half can be effected through the use of detachable trailers in connection with truck logging, according to actual tests conducted at Crossett, Arkansas by Reynolds. In a previous study of truck logging costs, it was revealed that the truck with attached trailer was idle in the woods from 25 minutes to an hour while it was being loaded, whereas by the use of detachable trailers an average time of 11.1 minutes was utilized in hooking on, and sending the truck back to the mill with its load. In addition to direct savings in truck operation time, loading crews while not under pressure to get the truck moving again build up better and larger loads. While the average load under the previous study was from 700 to 900 feet, the trailer method without special stakes averaged 1621 feet, and with stakes 1911 feet. If the haul is 19 miles or over, only one team is required for skidding and loading but if the haul is short an extra team and driver are needed. The operation requires two trailers to each truck, and each trailer must have a mechanical "horse" to rest on while being loaded. After being loaded, the trailer is picked up by the motor truck which backs into position. The "horse" on which the trailer rests is heavy channeled steel and is moved from one spot to another by the loading team. The swamper customarily used to brush out the sets for the truck performs the same service for the trailers and helps load. It was found that with loads of 2000 feet and over truck hauling can be conducted for 30 miles without costs rising too high.

The following table shows a comparison of hauling costs for various distances with attached trailers and with detached trailers both with and without special stakes. The cost figures include loading, hauling, truck depreciation and maintenance, licenses, etc., everything being covered except contractors' profit and

supervision. The distances include two miles through the woods, and the balance on a gravel highway. Statistics are for dry weather logging.

Costs per M feet Doyle log scale for truck haul

Distance	With attached trailers	With detached trailers	
		Without stakes	With stakes
<u>Miles</u>		<u>Dollars</u>	
5	3.34	2.10	1.71
10	3.64	3.15	2.56
15	4.82	4.20	3.41
17	5.47	4.63	3.75
18	5.79	3.84	3.11
20	6.27	4.17	3.38
25	--	5.01	4.06

RANGE ECONOMICS

Intermountain

The Land Policy Aspects of the Elko County, Nevada Cooperative Study was initiated in 1937. The area of the study is in northeastern Nevada, and includes all of Elko County and parts of Lander and Eureka Counties, in which lies the Nevada Grazing District #1 of the Division of Grazing and most of the Humboldt National Forest. There are approximately 10,800,000 acres of land within the exterior boundaries of this district, and 8,176,000 acres of public land reserved for grazing district, national forest lands 1,328,000 acres, and approximately 1,150,000 acres of railroad grant lands. Grazing lands owned by the ranches make up a relatively small percentage of the area.

The cooperating agencies interested in this study are the Intermountain Forest and Range Experiment Station and Range Management of the U. S. Forest Service of Region 4, the Division of Grazing, the University of Nevada, the Nevada State Farm Bureau, the Farm Credit Administration, the Agricultural Adjustment Administration, the Soil Conservation Service, and the Bureau of Agricultural Economics.

The purposes of the study were to analyze the problems of adjustment in land use in ranch organization, and in finance, and to translate the results of this analysis into public policy for land administration, credit, and taxation.

The area is of major importance in Nevada's range livestock production. Current use data indicates that the area contains about one-third of the range resource of the state. The more important problems of adjustment for the area are:

1. The lack of balance between the grazing capacity of the ranch properties and the grazing capacity of the range.
2. The lack of balance between the grazing capacity of the different seasonal ranges.
3. The situation that the capitalization of the ranch properties developed for cattle production is based upon a use of the range which the ranches have not been able to maintain in competition with the sheep operations.
4. The fact that property taxes on the deeded lands have been based upon an unstable control of the range by private land ownership, which will be changed as the public land reserved for the grazing district is brought under management.
5. The declining range condition of recent years and the overstocking and unusual use of ranges.

The range survey has been completed for most of the area. A survey of the capacity of each ranch property and its recent history of livestock numbers and range use is nearing completion. The plan is to summarize this material for natural geographic units. This will give the picture, for such units, of the relationship between the capacity of the ranch properties and the range, and the relationship between ranch and range capacity and recent seasonal use. This relationship between the capacity and the use of geographic units is complicated, however, by the extension movement of livestock, particularly sheep, and some new approach to this phase of the study must be developed.

One part of the study has been a ranch management survey of some 80 cattle ranches and 12 sheep ranches. It appears probable that the final completion of the original objectives of the study will require a more complete analysis of the organization of the sheep ranches and of the training of sheep to winter range south of the District 1 area. Some additional survey may be required of the winter ranges outside of the district, to complete the picture of land use and of the economic dependency of ranch

operations upon the different types of range.

The future policies of the Division of Grazing in the management of land and the allotment of grazing preferences in this district will have a direct relationship to policies on the national forest. The Elko County area study is unique in that it involves land use relationships between ranch properties and seasonal ranges that are geographically far apart.

The study promises to generate some new concepts in the economics of ranch and range interdependency.

STUMPAGE, LOG, AND LUMBER PRICES

Northern Rocky Mountain

In another month or so, the compilation showing prices paid for stumpage in the Inland Empire in 1938 will be ready for distribution. A poor lumber market in 1938 was reflected in stumpage prices, the prices in general being lower than in the preceding year.

Statistics compiled by the Division of Forest Products are being augmented this year with a new series; namely, "Log Prices in the Inland Empire." The source of the data is the questionnaire on stumpage and log prices submitted by operators each year in connection with the canvass of lumber production. For the purposes of compilation the Inland Empire has been divided into seven districts, and log prices will be shown for each species in each district. Through preliminary figures are not yet available, it is estimated that about 160,000,000 feet of logs are sold in the Inland Empire annually. About 70 percent of this volume is sold in the St. Maries-Coeur d'Alene-Spokane district, where many logbuying mills are located.

FOREST MANAGEMENT RESEARCH

FOREST FIRE PROTECTION

Allegheny

Behavior

The Fuel Type Manual which the Station is preparing in cooperation with the New Jersey Department of Conservation and Development is completed for South Jersey. Twenty-five fuel types have been described and illustrated by photographs. Description of the north Jersey fuel types has begun. The effect of a number of weather factors on fire inception and occurrence were determined from a three-year record, and a detailed summary prepared for the New Jersey Forest Fire Service.

Control

A guide for fire danger forecasting was prepared in the form of a modified fire danger meter. This is for temporary use this year, until a thorough test of the "All Region-7" meter and modification for New Jersey conditions are completed.

Appalachian

Fire Danger Measurement

Craig has spent considerable time during the past two months installing fire danger stations and checking and training observers. The 7 national forests of Region 7 will have 70 stations rating fire danger before the end of the spring season.

Thirty-five stations in the hurricane area in New England are also being equipped to measure and rate danger with the system used on the national forests. In Region 8, seven national forests, 2 national parks, and 1 Indian reservation are equipped to rate danger. With several experimental forests under the jurisdiction of the Northeastern and Allegheny Stations also operating danger stations, and a contemplated expansion to state-protected areas in North and South Carolina, there will soon be 15 national forests in 2 regions, 8 states, 2 national parks, 1 Indian reservation, and at least 8 experimental forests, all measuring the same danger factors in the same way, integrating the measurements similarly, and expressing danger in identical numerical terms.

Jemison initiated a test of the Appalachian danger meter on the the Ozark and Ouachita Forests early in March. The results of a two-weeks' inspection trip through Arkansas and a study of weather records, fuel types, and fire records indicate that this device may work very satisfactorily in the mountain areas of that State.

Goodwin is checking 2 danger meters on the Santee Experimental Forest in South Carolina and collecting detailed fire-weather and fire-behavior data to adapt the best of the present meters to coastal plain conditions.

One difficulty in obtaining good ratings of fire danger on fires, emphasized at the Washington fire conference, is that estimates of wind are seldom reliable. The following method, suggested by Byram, has been tried out on actual fires and has proved valuable in some instances. An observer watches a puff of smoke, a blowing leaf, or spark, and counts the number of seconds required for it to drift from one landmark to another, such as 2 trees from 10 to 20 feet apart. The time in seconds can be determined by using the "1000-one, 1000-two...." counting system. After pacing the distance of observed drift, wind in miles per hour is obtained from the following table:

Wind velocity as indicated by smoke drift

Time	Distance of smoke drift in feet											
	2	4	6	8	10	12	14	16	18	20	22	24
<u>Seconds</u>	<u>Miles per hour</u>											
1	1.4	2.7	4.1	5.4	6.8	8.2	9.5	10.9	12.2	13.6	15.0	16.3
2	.7	1.4	2.0	2.7	3.4	4.1	4.8	5.4	6.1	6.8	7.5	8.2
3	.4	.9	1.4	1.8	2.3	2.7	3.2	3.6	4.1	4.5	5.0	5.4
4	.3	.7	1.0	1.4	1.7	2.0	2.4	2.7	3.1	3.4	3.7	4.4
5	.3	.5	.8	1.1	1.4	1.6	1.9	2.2	2.4	2.7	3.0	3.3
6		.4	.7	.9	1.1	1.4	1.6	1.8	2.0	2.3	2.5	2.7
7			.6	.8	1.0	1.2	1.4	1.6	1.8	1.9	2.1	2.3
8				.7	.8	1.0	1.2	1.4	1.5	1.7	1.9	2.0
9					.8	.9	1.1	1.2	1.4	1.5	1.7	1.8
10						.8	1.0	1.1	1.2	1.4	1.5	1.6

Julien P. Friez & sons were awarded the latest Forest Service contract for fuel moisture scales. They have made several improvements in the design of the instrument, and cut the unit price to \$7.25. The scale has been remodeled to accommodate sticks weighing from 75 to 115 grams, oven-dry. Specifications for the Master Specifications File are now being prepared and steps are being taken to get the moisture scale listed on General Schedule of Supplies to make it more easily available to purchasers.

The precision of temperature control and differences in temperature found in different parts of gravity convection drying ovens have been debatable, among fire researchers at least, for some time. While we do not care to touch off an old argument, a recent test of the latest model Friez convection oven may be of interest.

With a number of thermocouples placed in the oven, Byram found temperatures that differed from the 100°C. true temperature by as much as -4°C. to +12°C. at the same instant. Variations in temperature, as the oven controls turned the heating units on and off, were as much as 8°C. at one spot in the oven. When an 8-inch non-oscillating electric fan was placed in the oven and allowed to run slowly, all temperatures measured in 9 different parts of the oven and measured as the current turned on and off were within ±0.5°C. of 100°C.

A \$5.00 electric fan, well oiled, turning at a slow rate, has held up through 5 months' use at 100°C. A 50-watt light bulb, hooked in series with the fan, provides the necessary resistance to slow down its normal speed. A more permanent installation with a fan inside the oven and its motor outside would be much more satisfactory, however. As yet we have been unable to find on the market a suitable size of this type fan.

The study of the effect of solar radiation on fuel moisture equilibria and rates of drying with "artificial suns," described in reports for last May and September, is nearing completion. Pending publication of findings, a note setting forth the highlights of the investigation will soon be prepared.

The study has proved the importance of radiation as a factor controlling fuel moisture content. It has been found that surface litter in sunlight dries faster in calm air than if the wind is blowing. Byram has found that 6 days of bright sunlight are required to dry out lower layers of litter after a heavy April rain, while surface leaves dry in 3 or 4 hours. Nine days of bright sunlight are required to dry lower litter to the same point in late fall. As much as 3 or 4 weeks of fall sunlight are necessary

to dry north slopes to a degree of inflammability comparable with that on south slopes in 5 or 6 days after a rain.

Calculations, checked by actual field tests, are available to show the rates of drying and fuel moisture equilibria expected on slopes of any steepness, any aspect, any time of day, or any season of the year. Such data are useful in determining the proper weight to be given to season of year as a danger variable, in locating danger stations properly, and in dispatching.

In connection with the "artificial sun" study, Byram devised a simple method for measuring total radiation by means of two identical ice calorimeters. Briefly, each device consists of a cylindrical cup of blackened copper surrounded by an ice-packed ring, and this in turn by a heat-insulating material. To measure radiation intensities, the inner cylindrical cups are filled with ice and both calorimeters are exposed to the same source of radiation, but the cup of one is shaded from the radiation. Water from melting ice drains through holes in the bottoms of the central cylinders or cups. From differences in the rates at which water runs from the 2 calorimeters, it is possible to compute the intensity of radiation in calories per square centimeter per minute. It is necessary to use the shaded calorimeter as a control because the inner cylinders will receive some heat regardless of insulation. Any one interested may receive a detailed description of this type of ice calorimeter by writing to the Station.

Some interesting differences in temperature and humidity at mountain top and valley bottom are being recorded in the study of fireweather at Bent Creek, where 6 stations are located on a line transecting the drainage from ridge to ridge. For example, it is not unusual to find 48 or more consecutive hours at high elevations when relative humidity stays below 30 percent, while during the same period in the valley humidity stays above 50 percent for about 30 of the 48 hours and remains below 30 percent for not more than 6 hours at a time. Plans call for eventually having continuous records of fuel moisture, wind, and precipitation at the 6 stations, as well as the temperature and humidity records now being obtained. Normal fire danger variations, caused by topography, may then be mapped and made available to dispatchers for adjusting ratings obtained at key stations.

Eye Tests. Available eye tests for forest lookout men have been found inaccurate unless given under one specific condition of light intensity. A method that would rate eyesight independently of light intensity on the target would be most useful if it were also simple and convenient for field use and rated men in terms of their ability to see small smokes.

Byram has produced a device that apparently will satisfy all the requirements for the most valuable type of eye test. While field checks are not complete, the device most promising is a black or grey target against a white background. The visual range of such a target is constant through a wide range of light intensities. This does not hold true for the standard Forest Service test (a small white target on a black background).

Basic work for this study included an analysis of the form of retinal images as modified by the diffraction of light. This analysis has a direct bearing on problems other than the eye-test study. It shows the highest useful magnification for telescopes and microscopes, explains the unusual visual powers of such birds as hawks and eagles, and has several other applications to general visibility problems. For instance, the analysis shows that the blurred edges of smoke bodies do not have an appreciable effect on their visual range, and that certain types of targets can be seen more clearly at a considerable distance than at close range.

Effects

A summary of tree mortality following fires of different intensities in mixed hardwood forests has been completed. The following table, based on measurements of 16 plots on 11 burned areas, indicates third-year mortality of all species in percent of original stand killed. The data are corrected for normal mortality expected in unburned stands.

D.b.h	Intensity of fire			
	Light	Medium	Heavy	Extreme
<u>Inches</u>	<u>Percent of original stand</u>			
1	56	83	100	100
2	36	60	76	100
3	24	44	58	84
4	15	33	45	67
5	10	24	34	53
6	5	17	25	41
7	4	11	17	30
8+	3	6	10	20

A statistical analysis of the effect of fire on diameter growth is nearing completion and in general shows that burning has little or no effect on surviving pole-sized crop trees. In white oak, black oak, and yellow poplar, basal wounding of as much as 75 or 80 percent of the trees' circumference had caused no significant decrease in diameter growth 5 to 14 years after the fire. In fact, slightly wounded trees showed a trend toward increased growth over unwounded trees, but this was not statistically significant. The study will not be considered complete, however, until a check has been made of the growth of unwounded trees on unburned areas.

Scarlet oak was the only hardwood studied that showed a statistically significant reduction in diameter growth following fire wounding. Unwounded trees, however, grew only 0.05 inches per year faster than badly wounded ones for the 14 years since injury, so little practical importance can be attached to wounding in this species.

The fact that basal wounding has apparently little effect on diameter growth, of course, should not be interpreted to mean that basal wounding is unimportant. Pathology has found, in analyses of records obtained in a joint field project, the amount of decay resulting in cull that is traceable to wounds of different sizes and ages. In some cases this cull does more damage in dollars per acre than the killing of trees by fire.

Such was true in the case of a light fall fire, data from which were used in the development of a method for appraising damage to the tree crop. This particular fire caused about \$1.60 damage per acre, of which \$1.00 was attributed to cull.

During the 14 years since a severe fire burned through a mountain stand of shortleaf pine, the surviving crop trees have grown as fast as similar trees on adjacent unburned areas. Within the burned area studies, however, trees which suffered severe crown scorching have grown significantly slower in diameter than have unscorched individuals.

A recent stem analysis of longleaf pine near Lanes, South Carolina, showed that 10 years of controlled annual burning had not significantly reduced the diameter growth of crop trees when compared to similar individuals on unburned areas. One severe accidental fire, occurring after at least 10 years of complete protection, was found to have decreased diameter growth by 0.03 inch per year for the 7 years since the fire. This amount, while statistically significant, seems to have little practical importance.

As will be noted from the above discussion, the Station's work in fire effects is concentrated on mortality, growth, and cull. From available analyses and summaries it is planned soon to prepare fire damage tables for mountain hardwood types based on fire intensity or severity. To make these tables most useful to federal, state, and private agencies, however, intensity should be expressed in terms of fire danger class.

Lake States

Control

Early in March, Mitchell attended a conference of State fire-control executives held in Milwaukee under the auspices of "State and Private Forestry." At this conference all of the States in Region 9 cooperating in fire protection under Section 2 of the Clarke-McNary Law were represented, with the exception of Ohio.

Among the subjects discussed were danger rating and damage appraisal. General satisfaction with the Lake States meter was expressed by the representatives of Michigan, Wisconsin, and Minnesota, and the Central States representatives asked for copies of the Central States meter to try out during the coming year.

Protection planning was also discussed at length, and the Station was asked to furnish the States with the results of its rate-of-spread and resistance-to-control studies, and copies of the tables prepared for the Region showing the average strength of attack required by fuel types to meet given standards of control. The outstanding feature of the meeting was the interest displayed by the States in fire research and fire-control planning and their desire to be kept posted and, as far as possible, to take advantage of research results and of Forest Service planning technique. It is unfortunate that more time and funds are not available to work on State fire problems.

Effects

The damage appraisal tables prepared a year ago for use in the Lake States were also reported to be satisfactory, and the preparation of similar tables for the Missouri-Ohio Valley region was requested by the Central States. For these, however, they were referred to the Central States Station.

Northeastern

Control

After a lapse of several years, the Weather Bureau has re-established the position of forest-fire weather forecaster at the Boston office. Mr. Arvy Lothman, who has been connected for the past several years with the forest-fire weather service of the Weather Bureau in southern California, has been assigned to the Boston office and reported for duty on March 15. In order to give Lothman a chance to become familiar with field conditions in the New England territory and also to become acquainted with local forest fire control agencies, Stickel and Lothman contacted all of the State and Federal forestry organizations during the latter part of March and visited many of the sites where forest-fire danger stations are to be established.

One of the results of the contacts with State Foresters, State Forest Wardens, and Forest Supervisors is a decision to subdivide the New England territory into seven forest-fire weather forecast districts. For the present, this subdivision is based largely upon well recognized differences in climatic conditions and major fire types. As rapidly as basic data from forest-fire danger stations are available and conditions warrant, these forecast districts will be further subdivided.

Although it may not be possible to have the ultimate network of forest-fire danger stations in operation in time for the opening of the spring forest-fire season, the New England region will eventually have almost 75 stations from which daily telegraphic reports will be forwarded to the Boston office of the Weather Bureau. Based upon these reports, the Weather Bureau will prepare two regular daily forest-fire weather forecasts, at 6 P.M. and around 11 A.M., that will be transmitted to a network of selected local radio stations in the individual states for broadcasting. The forecasts, in addition to covering in detail the weather factors influencing forest-fire danger, will contain a statement of the present average class of forest-fire danger for the forecast district in question and the predicted class of forest-fire danger for the next 12 to 24 hours. This new forest-fire weather forecast service will cover not only the hurricane area in which the New England Forest Emergency Administration is cooperating with local forest-fire control agencies, but also all remaining adjacent forest areas.

Northern Rocky Mountain

The Show and Kotok proposal, made at the recent Washington fire meeting, to broaden the damage base by evaluating and including the heretofore designated "intangibles" is receiving general

approval among administrative and research men in Region One. Although the consensus recognizes the difficulties, and the probable necessity of applying arbitrarily determined values in some cases, the process of arbitration may not be too troublesome. It is universally conceded that so long as our tape measure of damage is composed of one accurate section, i.e., the land survey, timber cruise, and stumpage valuations, and one inaccurate or rubberband section, i.e., the added claim that streamflow, erosion, wildlife, and recreation losses also are suffered, we have no real tape measure at all. Part is steel and part is rubber, and the ultimate measure depends on how hard the tape is pulled. An effort is being made to commence research work at least to bring these two parts of the measure into commensurate accuracy.

Concluding a 2-month detail to the Missoula office, McKeever returned to the Priest River station in mid-March. While in Missoula, McKeever coded the fire-weather data and danger ratings pertaining to all Region One fires of the 1938 fire season. This should be the last year that this work will be done by the experiment station, the new form 929 being so designed that these data will be added by the forest officer making out the original report.

The accuracy of Stewart anemometers after two seasons' field use was indicated by tests of eight instruments sent in by two forests as "of suspicious accuracy." One of these was found to have a bent spindle, cause unknown, which required replacement. The other seven underran true velocities of 4 and 6 m.p.h. by from 0.2 to 1.0 m.p.h., but at velocities of 8 to 16 m.p.h. the low-cost Stewart instruments were accurate to within 0.3 of a mile per hour. Velocities of more than 16 m.p.h. were not obtainable in the homemade, cardboard wind tube which Hayes and McKeever had to construct for this testing. A standard wind tunnel is greatly needed for this work which is being increased annually, with more than 250 anemometers in use in this region.

Pacific Northwest

Analyses of the fire danger station daily records from the 500 stations in the region have been made by Morris in order to determine the number of stations necessary in a given ranger district to give reliable daily values of fuel moisture and wind velocity. On the average, there are now 5 stations in an area 22 miles square (average ranger district), within which the elevation may vary 9,000 feet from the low valleys to high peaks. Some stations are on mountain peaks and some are not, but all are in clearings or openings. Preliminary analyses showed that the mountain-top stations must be investigated separately because their error variance differs from that of other locations. Separate analyses were also necessary for five geographic and climatic subdivisions of the region. It was found in general that for an area 22 miles

square the average mountain-top wind velocity could be estimated within 5 miles per hour of the true average if 5 stations are used, while to get the same accuracy in estimating the average for other locations 2 stations could be used. For the same unit of area the mountain-top fuel moisture indicator stick average moisture content can be estimated within 1.25 percent of the true average if 10 stations are used, but to get the same accuracy for other locations 14 would be necessary. The variance between stations on the same day on the same ranger district was used as the estimate of random error. Variances for all districts in the same climatic subdivision of the region were pooled.

A test of the weathering loss in dry weight of 100 of the fuel moisture indicator sticks used during the past season shows that in the dry parts of the region the loss was 1 percent and in the parts where rains are frequent during the early and late parts of the fire season the loss was $1\frac{1}{2}$ percent.

A further review by Wilkinson has been made of the consistency of the values in the tables used on the R-6 fire danger board which show the severity of burning conditions and the severity of variable items of fire danger corresponding to various combinations of fuel moisture, wind velocity, relative humidity, seasonal growth, visibility, and risk. New tables have been prepared which show much smaller divisions of the classes of burning conditions and of the classes of fire danger (based on burning conditions plus visibility and risk). These may be used principally for research purposes until the field is ready for more refined measurements.

The kind of oil most practicable for use in the R-6 type wind gages having two small annular ball bearings has been investigated recently by consultation with the Forest Service oil-testing laboratory, a local manufacturer of recording weather instruments, the New Departure Company, and a university. From the advice received it appears that mineral oils are not suitable for use on small bearings, especially where these bearings are subject to moisture condensation as may occur inside of a metal wind gage on cold nights or during damp weather. An animal oil such as porpoise oil appears to be necessary even though it is more expensive.

Southern

Control

Near the end of February, the field work on a study of fire detection in the grassy fuels of the coastal plain was completed. The study was begun to ascertain the time from origin to discovery, and the perimeter of the fire when discovered, for use in conjunction

with the rate-of-spread meter developed by Osborne and Olsen. A novel feature of this study was the use of radio to communicate between the field crew and the dispatcher. This enabled the dispatcher to distinguish positively between test-fire smokes and other smokes and also permitted the field crew to talk to the dispatcher as needed without tipping off the towerman as to where and when a test fire was to be set.

Effects

The scheduled burns in a study of the use of fire in bringing longleaf pine seedlings from germination to the initiation of height growth were made on the Palustris Experimental Forest during the second and third weeks of March. Six compartments, totaling 207 acres, were burned between 5 p.m. and 4 a.m. These burns were made later in the season than was originally planned, and relatively high winds plus extremely dry fuel made the burning more difficult than it would have been 6 weeks earlier, but satisfactory burns were obtained.

A notable development on this area has been the marked increase of brown-spot infection during the past year. Statistics are not yet available from the inventory but it is estimated that there is over five times as much infection present as there was last year. It was particularly pronounced on areas burned immediately before seedfall and unburned since. The pine seedlings date from the 1935 seed crop and are just entering their fourth growing season.

FOREST GENETICS

Northeastern

Breeding

The results of the 1938 tests of 58 different clones of poplar hybrids, being conducted by 27 Forest Service and Soil Conservation Service nurseries throughout the United States, are being compiled and appear to indicate a number of promising clones for each climatic region. The responses of all cooperators in supplying data requested has been highly encouraging. About 15 cooperators are arranging to have the best of their hybrid clones outplanted, and 12 have enlisted the assistance of responsible people such as experimental stations and forest schools to further

test specific clones under a variety of field conditions. Tests of additional clones are being made by many of the cooperators during 1939.

Segregation

Further work is being done this spring on testing the inherent nature of a high sugar content of the sap of sugar maple trees. Many environmental conditions are being taken into consideration and a number of high-yielding sugar trees were found this spring. Hourly and daily determination have been made with a hand sugar refractometer that increased the accuracy of the results secured this season. High and low sugar producers will be propagated vegetatively as clones and future tests made on these individuals growing under similar environmental conditions.

Propagation

Experiments in the rooting of dormant cuttings of white pine, sugar maple, and paper birch are being conducted this spring in the greenhouse. Cuttings taken at different periods from parent trees of several ages are being given various auxin treatments in an attempt to induce rooting. The results of last summer's work in the rooting of greenwood sugar maple cuttings have been presented in brief form in Technical Note No. 27 of this station.

MENSURATION

Allegheny

Stand Studies

Field work on the growth survey on the loblolly pine Sustained Yield Project in Worcester County, Maryland, has been completed. Out of a total of 4,663 increment cores obtained on forty 1/2-acre strip plots, 73 percent were pine and the balance hardwood. Radial growth tabulations, each in four five-year periods, have been made for punch card analysis.

Tree Studies

Because of recent requests for the information, our volume tables for loblolly pine in Maryland, in total cubic, merchantable cubic, and board foot units have been published as a Technical Note.

Central States

Tree Studies

The black locust data were prepared in form for the solution of the equations for basic tables. To facilitate handling these equations the data have been placed in logarithmic form. It is expected that this procedure will greatly lighten the tasks of establishing relationships and at the same time facilitate tests for linearity or departure from it.

To speed up the machine work, the Washington Office gave permission to do this work there and to utilize the equipment of the Computing Section. Adman left on February 27 to supervise this computing work, and returned on March 20. During the balance of the month additional progress was made on this study.

Lake States

Tree Studies

To assist the Superior National Forest in estimating jack pine pulpwood volume, the Superior Branch has made detailed studies of some of the factors that affect the volume of the cut. The summarizing of the field measurements, which has just been completed, shows losses due to (1) shrinkage after piling, (2) utilization to different top diameter limits, and (3) peeling. The wood was cut into 100-inch bolts to a top diameter limit of 3 inches inside bark. The results are given in the following table:

DBH of trees	Shrinkage 150 days		When utilized to --			Peeling
	Piled unpeeled	Piled peeled	4-inch	5-inch	6-inch	
			top d.i.b.	top d.i.b.	top d.i.b.	
	<u>Losses in percent</u>					
5	2.4	2.6	40.0	100.0	100.0	12.8
6	2.4	2.6	22.5	57.8	100.0	12.0
7	2.4	2.6	12.5	35.0	74.0	11.5
8	2.4	2.6	7.8	22.7	50.0	10.1
9	2.1	2.2	4.5	14.0	22.5	9.0
10	2.1	2.2	2.0	7.5	18.4	8.4
11	2.1	2.2	.5	2.9	8.0	8.1
12	2.1	2.2	0	0	1.0	8.0

Pacific Northwest

Stand Studies

The third report for the Deschutes permanent sample plots in even-aged ponderosa pine summarizes a 10-year record of their growth and mortality. Since these are the only permanent sample plots in this type in the region and since their growth rate has been remarkably high the record is of exceptional interest. On land that measures site quality class IV this stand, at an average age of only 72 years, has accumulated a volume of 5,500 cubic feet or 13,700 board feet, Scribner rule, per acre. This stand at present, however, is badly in need of thinning and pruning. Although it has accumulated a heavy volume and has apparently always been densely stocked no high quality volume whatever has been produced and apparently none will be produced for many years because the dead limbs extend virtually to the ground on the crop trees. According to the recently completed normal yield table for this type, this stand is considerably overstocked, having 130 percent of the normal basal area. Mortality due to activity of the mountain pine beetle is increasing greatly, apparently as a result of the severe stand competition.

REGENERATION

Appalachian

Planting

Planting on the remainder of the experimental plots established in cooperation with the T. V. A. was completed in January and February 1939. A total of 700 plots comprising about 162 acres of net plot area has now been completed.

Field examination of the plots planted in 1938 showed survival to be uniformly excellent. This will allow good experimental comparisons of later survival and growth of the various species on the different sites. Because of the obvious uniformity of first year survival results, no formal statistical analysis has been made.

Appalachian

Seed Studies

Records for 3 years are available for the study of the production of acorns of 5 species of oaks in the southern Appalachian Mountains. Seed traps were placed under 210 trees and weekly counts of acorns were made during the period of production from the first week of September until about the last week of November. More than 50 percent of all acorns produced were either immature or deformed; 20 percent were damaged by rodents or weevils while still on the tree, and 27 percent were apparently sound. Cutting tests of the sound acorns showed about 70 percent to be viable. The following table shows the average yearly production of acorns per tree on a 1 milacre basis. It should be noted that the scarlet oak, the least desirable species, produced by far the greatest number of viable acorns.

Average yearly production of acorns per tree
on a 1 milacre basis

Species	All acorns	Acorns immature or deformed	Well developed acorns, damaged by rodents or weevils	Well-developed acorns, apparently sound	Number of sound acorns that are viable
White oak	31.1	22.9	4.3	3.9	3.0
Chestnut oak	9.3	2.2	3.4	4.2	3.6
No. red oak	20.8	9.8	3.6	7.4	5.2
Black oak	33.8	19.9	7.1	6.8	3.3
Scarlet oak	43.2	19.5	8.6	15.1	10.9

Central States

Planting

Field planting of experimental plots began on the Main Division of the Ozark Forest shortly after the middle of February and progressed during March into Missouri, Illinois, Indiana and Ohio. This phase of work will be completed early in April.

In previous years, there has been high mortality among one year seedlings in direct field seeding experiments. Spring counts on last year's plots revealed the usual heavy losses, especially on unprotected spots.

Nursery

Statistical analysis of nursery soil experiments of last year are nearing completion. A very interesting example of the possibilities of soil investigations appeared in the case of two series of fertilizer experiments established last spring at the Federal Forest Nursery at Licking, Missouri. The two series of 66 plots each were identical as to fertilizers, seed, preparation, and time of seeding.

The only apparent difference was that Series I was on fallowed soil, whereas Series II was on soil previously in pines. Series I was almost a complete failure; Series II was excellent as to seedling survival and growth. This remarkable response to inoculation, especially if it be somewhat spotty, may mask tests made to determine the effectiveness of fertilizer unless the experiment is well planned and thoroughly randomized. One may secure significant response one year to fertilizing and the next year get no response if the soil in the interim becomes inoculated.

Phosphates seemed to compensate in a surprising degree for lack of inoculation.

Potassium sulfate showed significant increase in seedling survival on fall-seeded shortleaf pine in the Vallonia, Indiana nursery, and highly significant increase on spring-seeded shortleaf pine in the Licking, Missouri nursery.

Nitrogenous fertilizers of all kinds proved unfavorable to seedling survival when applied at seeding time. The amounts applied probably were excessive (100 pounds per acre) but even soybean meal and dried blood decreased survival. The fact that organic nitrogenous fertilizers reduce survival indicates that even small amounts of nitrogen in the soil at germination time favor damping-off organisms. If the injury were chemical in nature one would expect the soluble mineral nitrate or ammonium sulfate to be most injurious. Such is not the case. Smaller amounts applied later in the season will be tried this year.

Intermountain

Planting

Survival of ponderosa pine. Repeated experimental plantings over a 5-year period in the granitic soil province of central Idaho have indicated that on southerly aspects ordinary nursery stock, whether of seed bed or transplant class, can be expected rather consistently to fail. The magnitude of differences between survival by aspects may vary greatly from year to year, depending on the severity of heat and drought factors, but apparently even in favorable years the southerly situations do not produce a satisfactory response. Table 1 illustrates several different classes of ponderosa pine stock on three different aspects.

Table 1.- Average first year survival percentage by aspects.
(Ponderosa Pine, central Idaho).

Source and class of planting stock	Aspect		
	Combined draw and creek bottom plots	All northerly aspect plots	All southerly aspect plots
Wind River 1-1 Stock ('34)	38.0	25.2	5.5
" " 1-2 " ('34)	53.4	31.5	10.9
" " 2-0 " ('37)	45.6	38.2	8.5
" " 1-2 " ('37) ^c	42.6	39.1	11.0
Savenac 2-0 " ('37)	26.5	23.6	7.5
" 2-2 " ('37)	45.0	35.4	12.7
Monument 2-1 " ('37)	38.0	36.0	10.0
Mean	41.3	32.7	9.5

^c This transplant stock was planted at the same time as the seed bed stock of the same origin but the planting was made so late in the spring that the large tops of the transplant seedlings proved in this case to be a liability.

When one considers that these data represent first year survival only, it is plain that even the choicer aspects do not present an encouraging picture. Invariably, second season losses result in significant reductions in stocking, and this means practically complete failure on the more unfavorable situations. An indication of the trend of survival beyond the first growing season is given in table 2.

Table 2.- Trend of survival percentages for the first three growing seasons on a series of planting plots. (Ponderosa pine, central Idaho.)

Class of stock	1st growing season	2nd growing season	3rd growing season
Plots lightly grazed			
2-0	26	14	12
2-0	42	27	23
2-0	52	24	23
2-0	52	44	42
1-1 & 1-2	37	26	23
2-1	52	37	31
Mean	44	29	26
Plots heavily grazed			
2-0	57	39	25
2-0	80	49	25
1-1 & 1-2	77	64	55
Mean	71	51	35

Ordinarily the heavy losses take place in the first two growing seasons, and the losses thereafter are practically negligible. This is not apparently true, however, on areas where live-stock grazing is heavy. Though not a major cause of mortality, grazing is always directly or indirectly responsible for an appreciable number of losses, and in the case illustrated in table 2 was the primary cause of the significant loss after the second growing season.

Considerably better results can be doubtless obtained through better planting technique, rigorous grading, and culling, even when ordinary planting stock is used. For example, the data in table 3 will serve to illustrate what subsoiling can do.

Table 3.- First year survival percentages for deep hole and shallow hole planting methods by class of planting stock.
(Ponderosa pine, central Idaho.)

Plot No.	Savenac Nursery Stock			
	2 - 2		2 - 0	
	Deep hole method - 18 inches deep	Shallow hole method - 10 inches deep	Deep hole method - 18 inches deep	Shallow hole method - 10 inches deep
31	28	16	11	10
63	15	10	14	4
51	3	5	4	3
44	55	41	26	16
61	30	10	24	11
50	40	35	39	24
36	49	41	31	21
62	20	15	24	11
Mean	30	22	22	15

Despite the fact that this test employed only ordinary planting stock (with roots pruned at 8 to 10 inches) the subsoiling was definitely beneficial except on the severest sites. It is not known how much larger the differences might have been, if stock with husky taproots at least 15 inches in length had been planted into the deep holes instead of the severely pruned ordinary stock.

Grade or size of seedling also is an important factor controlling survival. Preliminary tests in 1938 (which was a favorable year) showed that 2-0 stock grown in the Bannock Creek experimental nursery from a native seed source gave 90 percent survival for grade 1 stock, only 79 percent for grade 2. A comparable test using 2-1 "foreign" stock showed 78 percent survival for grade 1, 58 percent for grade 2, and 30 percent for grade 3.

Growth of ponderosa pine: Growth performance of ordinary nursery stock has been generally poor. Apparently a long period is required for the seedling to recover from the "traumatic" shock of root pruning and transfer from the nursery to the harsher environment of the field. Nevertheless, there is an element of hope for improvement in seedling growth performance, because of the strong relationship between initial size class of seedlings and the subsequent height growth. This relationship is illustrated by the following data:

Initial height							
class - 2-0 pon-	0.5-1.5	1.5-2.5	2.5-3.5	3.5-4.5	4.5-5.5	5.5-6.5	
derosa pine -							
inches							

Annual height							
growth - inches	1.08	1.31	2.24	2.55	3.19	3.94	

For the first five growing seasons or so in the life of the plantation, the relationship is roughly linear, and can in this case be expressed by the following regression equation:

$E_H = 1.6399 H_p - 0.0694$, where E_H is estimated height for the following year, and H_p is height at present.^o It is evident that the larger seedling enjoys a real advantage from the standpoint of growth, this advantage counting large in the competition against associated vegetation. The significance herein lies in the fact that ponderosa pine tends to express dominance already in the seedbed stage, making possible a greater control of seedling growth performance in the field through culling and grading practices.

^o The standard error of the regression coefficient is ± 0.09 inches with the "t" value (118 degrees of freedom) equal to 18.06. Equation valid for a height range of 1 to 10 inches.

Lake States

Nursery

The Use of Tensiometers in Nurseries. Investigations of tensiometers as an instrument for making quick and reasonably accurate determinations of soil moisture in forest nurseries commenced two years ago. During the summer of 1938 all of the Forest Service nurseries in Region 9 used tensiometers on a trial basis to learn how useful the instruments might be.

At one Region 9 nursery last summer, the tensiometer readings showed that unnecessarily large quantities of water were being applied. Since the soil was a very light sand, the excess water simply drained away through the soil. Moreover, it is likely that expensive fertilizers were wasted through leaching. One tangible saving effected by curtailing watering was a reduction in the electric-power bill for water pumping from \$428 during the month prior to the reduction in watering, to approximately \$150 for the following month.

The Forest Arboretum on the Chippewa. Plans for the coming spring include the planting of eight additional species in the Chippewa Branch arboretum. To date, 11 species have been planted in plots of 0.3 acre each, and 2 species on plots of 0.1 acre. During the 2½-year period since the arboretum was started, 9 other species have failed to survive the first winter in the nursery. An attempt will be made to grow, under forest conditions, all species hardy to the region.

Stock for additional plantings in 1940 and 1941 are now in the branch station nursery, and new lots of seed from Sweden, Germany, and western United States have been arranged for. This work will be continued as opportunity for obtaining new species or strains arises.

Seed Studies

Time of Fall and Germination of Jack Pine Seed. A reproduction study for which the analyses of data have recently been completed shows that jack pine seeds are likely to germinate at any time when the ten-day average maximum air temperature exceeds 64° F., if moisture conditions are favorable. In northeastern Minnesota, where the experiment was carried out, the germination period extends roughly from May 10 to September 30. This was determined by sowing jack pine seeds at eleven different dates spread over a 12-month period.

As might have been expected, the seedlings that germinated early in the spring survived better than the ones that germinated later in the season. Since jack pine seeds are apt to be disseminated from slash at almost any time of the year, especially from early spring to late fall, the possibility that the seeds will germinate whenever precipitation is abundant between May and September, complicates the process of developing a reliable method of encouraging natural regeneration.

Dewinging Methods for Jack Pine Seeds. Much concern is being shown by some of the administrative men over the rather poor germination obtained from jack pine seed, even that freshly collected. Although some individual samples show as high as 85 to 88 percent germination, the average of all samples tested in the station's laboratory during the last two years was only 61 percent. Red pine, on the other hand, consistently gives 90 to 95 percent germination, with some samples as high as 97 percent. It is the thought that the poor showing made by jack pine may possibly be due to injury to the seed during dewinging, since the seed coats are relatively thin and brittle, and easily damaged.

The station accordingly plans to run a dewinging test with such seed. Seed will be dewinged at the Cass Lake Nursery by the usual method of treading in a grain bag, and a comparable lot of

the same seed will be dewinged in the St. Paul laboratory by several methods, including gentle rubbing between the hands, beating in a bag, rubbing with stiff brushes, and removal of each wing individually by hand. If there appears to be any difference between the germination of the Cass Lake seed and that dewinged in St. Paul, the test will be repeated on seed from other extrac-tories in the region.

Planting

That different methods of planting may affect survival measurably is rather generally accepted, but that variations within a method may have similar effects generally has been over-looked. Tests conducted on the Huron National Forest indicate the importance of the second case.

In the spring of 1937, 2-0 jack pine stock was planted by the normal "wedge" method (slope of the hole at about a 45-degree angle), by a modified wedge method (roots placed shallowly at no point deeper than 4 inches below the surface), and by the stan-dard slit method. At the end of the second year after planting the survivals for these three methods were, respectively, 62, 89, and 69. Apparently the shallow wedge hole, which puts the roots in a position most like that of a natural seedlings, is definitely superior for use with jack pine under these conditions.

Northern Rocky Mountain

Planting

Schopmeyer reports that total first-year mortality among seedlings grown from seed under screens in direct seeding plots in the western white pine type was only 19 percent during the 1938 growing season. This figure is less than half of the average first-year mortality percentages for either natural reproduction (43 percent) or planted stock (42 percent). Data on germination and first-year mortality in screened seed spots is presented in the following table.

Germination and first-year mortality in screened spots
in direct-seeding plots during 1938 growing season. 1/

Location of plots	Species	Germination		Mortality	
		Fall sown	Spring sown	Fall sown	Spring sown
		<u>Average number of seeds germi- nated per spot</u>		<u>Percent of germination</u>	
Kaniksu N. F.	Ponderosa pine	24.4	5.6	5.4	19.0
	Western white pine	9.8	1.5	19.4	35.2
Coeur d'Alene N. F.	Western white pine	28.8	4.4	14.1	10.2
	Engelmann spruce	25.8	25.3	21.9	25.7
Average for all species		22.2	9.2	15.2	22.2

1/ Each figure on fall-sown seed is based on 288 spots; each figure on spring-sown seed is based on 192 spots.

Mortality data on unscreened spots is omitted from the table because of insufficient numbers of seedlings on which to base percentages.

Analyses of the mortality data brought out the following important points:

1. The causes of mortality in the decreasing order of their destructiveness were cutting by biotic agents, drought and insolation combined, and damping off.

2. Losses caused by damping-off were approximately the same for all three of the species studied.

3. Losses caused by drought and insolation combined were greatest in Engelmann spruce, intermediate in western white pine, and least in ponderosa pine.

4. Losses caused by cutting were greatest in Engelmann spruce, intermediate in western pine, and least in ponderosa pine.

The fact that drought and insolation were secondary to cutting by biotic agents in destructiveness is contrary to results of mortality studies on natural reproductions which show that drought and insolation are the primary caused of death among seedlings. This inconsistency may be attributed to two factors: (1) the screens may have had an ameliorating influence on surface soil temperatures, and (2) the shade produced by the closely spaced seedlings within spots may have kept surface soil temperatures below the critical point for a part of the critical period.

The low mortality cannot be attributed to favorable weather because Weather Bureau reports show for the 4-month period June-September 1938, inclusive, that the mean monthly temperature was higher than normal and that precipitation was less than normal for the northern division of Idaho.

Southern

Nursery

During February conference was held with W. R. Hine, in charge of inspection under Section 4 of the Clarke-McNary Act for Region 8, to discuss grading specifications for southern pine nursery stock. Some criterion of performance in terms of quality of trees produced is essential to an adequate inspection of a state nursery receiving aid from federal funds, and Hine is inclined to use the Station's published grading rules (Tech. Bull. 492), amended to include the size-specifications set up for the Ashe and Stuart nurseries. Meanwhile instances are multiplying which show that the correlation between nursery grade and field behavior, while high, is by no means complete, and the Station's 1937-38 survival studies show that the survival of grade 1 seedlings can be reduced or increased by modifying their stored food reserves.

Because of these findings, there tends to be an argument if grade rules are enforced to the point of working any hardship on the nurseryman. A particular case in point has arisen in nurseries growing stock for the Soil Conservation Service under contract, with the provision in the contract that the S.C.S. do the grading. Under present plans, the argument may involve 80 to 100 million seedlings a year. The matter is important enough to necessitate a thorough review and evaluation of all the Station's material on grades, before next planting season.

Arboretum. During February and March some 40 species of trees were planted in the Arboretum on the Harrison Experimental Forest. Most of the planting stock was supplied by nurseries of

the Soil Conservation Service. There are at present more than 90 species of native trees and 15 exotic species planted in the Arboretum.

Planting

During February new plantations were established on the Palustris to study the effect of food reserves, root-stimulation, and grade upon survival of longleaf and slash pine. The food-reserve phase was designed to amplify last year's findings concerning the differences in food storage under different seedbed conditions through the winter, and to learn their effects on survival. The root stimulation studies included treatments with Hormodin A, and also late fall and early winter root-pruning in place, to increase the likelihood of establishment of new roots in place after late-winter planting. The grade studies (confined to slash pine) were elaborated to include top-root ratios and also transpiration-retarding sprays (fish-oil soap, bordeaux mixture, linseed oil, and an asphalt rodent-repellent.)

Seed Studies

The portion of the study of equilibrium moisture content relations of longleaf seed that involved the seed itself was taken down during March, and a chart was prepared showing the temperatures and humidities necessary to produce various moisture contents in the seed. This chart indicates that to maintain seed at less than 10 percent moisture content in unsealed containers at 38° - 40° F., the relative humidity of the storage chamber must be much lower than the 60 to 80 percent encountered in many commercial cold storage plants, probably between 35 and 40 percent. This chart is being submitted to Region 8 in a confidential report at a program conference in Atlanta April 5, for guidance in preparing specifications for seed storage chambers.

The chart checks fairly well with the few independent examples of seed stored under known conditions of temperature and humidity. It needs refinement, however. An attempt to check the scanty published data on humidities in sealed chambers met with failure because of inadequate original grasp of the physical principles involved. The problem encountered was laid before the Physics Section of the New Orleans Academy of Sciences and two members of the section have collaborated on a promising solution. This will be tried at an early date, and if it works the chart will be refined and prepared for publication.

SILVICULTURE

Allegheny

Silvics

A technical Note on seed productivity of chestnut oak in southern New Jersey summarizes a ten-year record on two adjacent trees. As had been suspected, certain trees may show a definite periodicity in seed production, while others, comparable in size and age, may produce little or no seed in any year.

Harvest Cuttings

As an informal follow-up of our studies of seedbed conditions for pine, Little cooperated with the New Jersey foresters in planning a series of CCC demonstration plots where various methods of encouraging pine reproduction in south Jersey stands now dominated by oaks will be tested. In all, twenty-one acres were selected for these demonstrations. Six treatments and a control, each replicated once, will be used in each plot. The treatment consists of cutting all oaks, and thinning the pine if necessary to secure a good distribution of seed trees, combined with various types of slash disposal and of mechanical treatment of the soil surface. Some method of exposing the mineral soil is doubtless necessary in most of these stands in order to replace the decadent sprout oak with seedling pine.

Appalachian

Harvest Cuttings

Loblolly Pine Second-Growth. Cutting of the 6 plots of Block 3, located on the Duke Forest, was completed early in February. All trees on the plot were converted into peeled pulpwood and will be sold to the West Virginia Pulp and Paper Company at Covington, Virginia, by the Duke School of Forestry.

During the latter part of February representatives of the Station accompanied the Management Staff Assistant of the South Carolina National Forests to the Santee Experimental Forest, where an appraisal was made of the pulpwood and saw timber to be removed from the cutting areas of Block 4, and where final arrangements were made for a timber sale. Six hundred cords of pulpwood and 113 thousand board feet of saw timber were advertised for sale. A pulpwood contractor for the West Virginia Pulp and Paper

Company at Charleston, S. C., was awarded the bid the last of March. Cutting is expected to be started about the first of May.

Central States

Harvest Cuttings

A study on the release of natural pine reproduction and saplings was started. The study is designed to find out whether or not the scattered individual hardwood trees (remnants of the last stand, regardless of their merchantability) that overtop pine, should be removed. It will take into consideration the present and future merchantable material in the overstory trees and the effect they have on the growth rate of the different sized pine at different distances from the overstory trees.

During February and March analysis of the data obtained in the Reproduction Release Study which was initiated last winter was continued. The analysis of the data on planted pine has been completed and the results are to be released in the near future.

Stand Improvement

In company with Ranger R. J. Schaar of Athens, Ohio, on February 7-9, Kuenzel examined previously treated areas on the Wayne Purchase Unit. In a white oak pole stand, pruned in 1936, callous tissue was forming satisfactorily with no evidence of decay present. Epicormic branches were almost entirely lacking on the pruned stems. Of particular interest were the accumulation of leaf litter and the presence of numerous seedlings and sprouts on an area where pruning slash was left in windrows parallel to the contours at about 50-foot intervals along a 15 per cent slope.

Intermountain

Harvest Cuttings

A few figures on growth and mortality of selectively cut ponderosa pine stands in central Idaho, as computed for a long-delayed report on the subject, may be of interest to other workers in that type. Five old timber sale areas on national forests were examined in 1932 to obtain more extensive measurements of the results of cutting than were provided by permanent sample plots. The complete results of the study cannot readily be expressed in brief form, as there was such a complex of factors affecting growth on each area; the following summary is only to show gross differences between areas and to allow rough comparisons with data for other regions.

Reserve stand and annual increment per acre since cutting.

Area No.	Years since Cutting	Reserve Stand ^o		Gross Increment	Mortality	Net Increment	Net Growth Percent
		Number Trees per Acre	Volume				
			Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Percent
1	25	16	6,132	137	33	104	1.7
2	7	17	3,599	96	74	22	0.6
3	8	15	3,238	75	27	48	1.5
4	8	11	2,942	96	10	86	2.9
5	10	13	1,942	56	13	43	2.2

^o Number and volume (Scribner Dec. C) of trees 9.6 inches d.b.h. and larger only; all species; at time of cutting.

The net growth on all of these areas is somewhat less than had been generally anticipated. The fact that the periods of time covered were largely within an unfavorable growth cycle undoubtedly contributed to the poor showing. Probably the best results from the standpoint of net increment were on the fourth area, principally because the original stand was such as to allow the reservation of a large proportion of immature, thrifty, well spaced trees. With an initial volume of less than one-half that on the first area, the fourth area produced a net increment equal to 83 percent of the rate on the first. However, in 1932 the first area yielded a volume of 3,040 board feet in trees 28 inches d.b.h. and larger out of a total volume of 8,734 board feet; while the fourth area, assuming growth at present rate continuing for a total of 25 years, would yield a volume in that size class of only 1,591 board feet out of a total of 5,304 board feet per acre. Thus, the first area tends to compensate for its slow rate by adding more volume increment of clear wood and making possible an earlier and more profitable second cut.

Lake States

Harvest Cuttings

A light selective cutting at the Upper Peninsula Experimental Forest made last year, but recently analyzed, provided much needed information on the type of logs and products that can be cut from trees of inferior quality. The general summary below shows the proportion of different products that were actually cut from trees of different diameters. The total cut involved about

40 M board feet net by Scribner rule, 40 percent of which was in saw logs and the remainder was culled as chemical wood. The table does not consider chemical wood obtainable from tops and limbs or portions above the merchantable bole. Furthermore, no ties or mine props were utilized. The figures are based on sugar maple only, which comprises 90 percent of the total volume of the stand.

Distribution of Total Board-Foot Volume by Products

Sugar Maple		Dukes, Michigan				
DBH class (inches)	Percent of gross volume in					
	Veneer logs	No. 1 logs	No. 2 logs	Chemical logs	Cull	Waste
10-12	0	2.0	0	97.0	1.0	0
13-15	0	9.5	3.5	82.0	5.0	0
16-18	0	20.5	7.5	63.5	8.5	0
19-21	3.0	25.5	9.0	52.5	9.0	1.0
22-24	8.0	23.0	11.0	46.5	9.0	2.5
25-27	7.0	22.5	14.0	45.0	9.0	2.5
28-30	3.0	22.0	17.0	47.0	8.0	3.0

Veneer logs are at least 6 feet long and have a minimum top diameter of 14 inches inside bark. They must be generally free from defects, but one or more standard defects or their equivalent are allowable in larger logs, depending upon the general quality of the log.

Number 1 logs cut over at least 60 percent lumber, number 1 common or better. They are 12 inches or larger in diameter at the top end and 12 feet or more in length.

Number 2 logs contain at least 30 percent of number 1 common lumber and have a minimum length of 8 feet and a minimum top diameter of 8 inches.

Any log that does not contain 30 percent of number 1 common lumber is called a chemical log.

Cull represents deductions for decay or other defect that makes the wood unusable. Left-over odd sections of merchantable bole which, although sound, are too small to be utilized are called waste.

It will be noted that a greater proportion of highgrade material came from trees 22-27 inches d.b.h. than from larger or smaller trees in the light "silvicultural" type of cutting used. Trees under 18 inches d.b.h. yielded very few good logs.

Northeastern

Silvics

Hurricane damage. In tallying the trees on Gale River Experimental Forest damaged by the hurricane of September 21, 1938, notes were taken as to whether the trees were uprooted or broken and whether the broken trees were sound at the point of break or defective.

It is interesting to note how the combined effect of the prolonged rain storm and the hurricane is reflected in the type of the damage. The soil was completely saturated with water at the time of the hurricane; thus did not give a sufficient anchorage to the trees. This is evidenced by the fact that of total damaged trees only 5.3 percent were broken. Of this number 71.3 percent were defective at the breakage point. The sound broken trees were mostly smaller ones damaged by the fall of the large trees. This is strikingly brought out in the case of two species, red spruce and yellow birch, where a greater percent of sound trees than defective trees was broken.

Soil Fauna: The analysis of sample 37F4 from undisturbed, long unburned spruce woodlands has been completed. It was found to differ from the first sample analyzed in being a much deeper accumulation (to 16 1/2 inches deep) and in containing five to six times more microarthropods, a total of 110,000. See Table.

It is immediately obvious that sample 37F4 is much the richer in both number of species and number of individuals. It is also richer in that most species of saprophagous mites and of springtails are much more numerous than in 37F1. Of the seven species which are more numerous in 37F1, three are *Brachychthonius* and one is *Pseudotritia ardua*. All this suggests that 37F1 suffered from a certain amount of trampling due to proximity to a cruise line, and is therefore an impoverished sample. Even in the lowest layer (13 1/2 to 16 1/2 inches deep) there were 4008 individuals.

It is thus evident that the deeper the organic layer (raw humus) the greater the fauna. These figures, coupled with those obtained at the Bent Creek Experimental Forest in North Carolina, and the observations made on several other samples not yet analyzed, indicate that the saprophages of the humus are unable of

themselves to completely reduce the humus or of preventing its accumulation. They must be aided in this role by animals outside the humus itself, animals not present in highly acid soils.

Comparison of the species of the two samples which are only 920 feet apart shows that five saprophagous mites and four spring tails of 37F1 (not of accidental occurrence) did not occur in 37F4. This still further emphasizes the uneven distribution of the litter fauna even in a uniform woodland, undisturbed and unburned over a period of hundreds of years. To determine the fauna of a stand it is therefore necessary to take compound samples (five cuts within a few feet of each other) in at least three, preferably five places within the stand.

Table

Totals								
	Saprophag. Mites	Other Sap. Mites	Spring- tails	Insects, etc.	Total Saps.	Predators	Suckers	Grand Total
Sample 37F1 Individuals Species	9937 66	710 5	2839 22	108 15+	13,594 108	3575 43+	2724 33	19,893 184+
Sample 37F4 Individuals Species	23,935* 84	3572+ 6	14,125 27	307 26	41,939 143	40,469 49	11,565 39	94,000* 231

* plus immature Oribatidae (about 16,000)

Northern Rocky Mountain

Stand Improvement

Approximately 4,265 acres of thinnings, liberation cuttings, improvement cuttings, and pruning were examined on the Kaniksu, Coeur d'Alene, and Lolo National Forests. The following table shows the acreage examined by species, national forest, and type of stand improvement work. Although no attempt was made to cover all areas on which stand improvement work had been done, a special effort was made to examine most all thinning and pruning areas on the three forests.

Acreage of areas examined by timber type, national forest, and type of stand improvement work.

Forest type	National forest	Acreage examined by type of work			
		Thinning	Pruning	Improvement cutting	Liberation cutting
Western white pine	Coeur d'Alene	275	<u>1</u> / 315		10
	Kaniksu	225	<u>2</u> / 60	680	600
Ponderosa pine	Lolo	2310			

1/ Approximately 150 acres in areas also thinned.

2/ All in areas also thinned.

A unit report form applicable to all types of stand improvement work was devised. One of these was prepared for each area studied, giving in as complete a manner as possible data of the stand before and after treatment, man-day and cost figures, crew organization and techniques, maps of the areas treated, and other information of value. Field work consisted mainly in obtaining stand information and in gathering together all available information concerning each area from miscellaneous records and from persons familiar with the study area.

The study has already assembled worthwhile summary information on crew organization, output, and the relative efficiency of various treatments, all of which will aid in planning C.C.C. stand improvement projects. Probably of greater value are the uniform unit reports which, giving a complete picture of the stand and work done as they do, will allow the various areas to be used as study

units to be reexamined from time to time thus determining the success or failure of the various stand improvement measures.

Pacific Northwest

Silvics

The first phase of a Douglas fir knot study was completed by Bransford. It brought out that an average of 54 years elapsed between the time a limb died and fell off and the bole started adding clear wood on the first 16-foot log in 100-year-old timber of good density.

The study of seed fall under timber indicated a heavy crop for hemlock, a medium crop for Douglas fir, and a light crop for cedar and lowland white fir. Under virgin timber the fall per acre was 3,000,000 for hemlock, 250,000 for Douglas fir, 75,000 for cedar, and 1,260 for lowland white fir. These figures are interesting when it is realized that out of over 3,000,000 seeds per acre probably not more than an average 3 seedlings will become established and produce mature trees.

A progress report of natural restocking on a Douglas fir cut-over area in the lower Columbia River region showed adequate restocking for a distance of a quarter mile from green timber during the 11 years following cutting. Roughly the density of restocking was inversely proportional to the distance from green timber. The records showed northerly exposures far more favorable for restocking than level ground or south exposure.

Computations were completed for the soil moisture study of last summer at the Pringle Falls Experimental Forest. The following table shows the average percent moisture content of the soil at different depths in the ponderosa and lodgepole pine types for samples taken at weekly intervals from July 18 to September 6:

<u>Soil depth</u> <u>Inches</u>	<u>Percent moisture content</u>	
	<u>Ponderosa pine type</u> <u>Percent</u>	<u>Lodgepole pine type</u> <u>Percent</u>
1	2.1	3.1
6	9.1	10.0
12	14.4	17.8
18	22.7	25.2
24	20.0	20.1
30	13.9	17.4
36	12.8	16.4
42	13.2	17.5
48	14.1	17.5

Stand Improvement

Reports by Welch and Kachin show that crop trees properly released by spot thinning have in the first decade following release made more than double the diameter growth of unreleased trees of similar size. However, on most of the spot-thinned areas examined the release given was far from adequate. Instructions designed to correct this and other common faults of past stand improvement practices have been drawn up and added to the Regional CCC Handbook.

Harvest Cuttings

The data taken in the Malheur growth and mortality study on the Hines Lumber Company sale were tabulated on cards, stand tables were constructed, and a report was written by McKay. The following table shows the residual stands of ponderosa pine left by the two variations of the maturity selection cuttings in the two timber types on the study area:

Residual Stand on Per Acre Basis

Marking Rule #1				Marking Rule #2				Grand Average	
South slope timber type		North slope timber type		South slope timber type		North slope timber type			
No. of trees	Vol. bd.ft.	No.of trees	Vol. bd.ft.	No. of trees	Vol. bd.ft.	No.of trees	Vol. bd.ft.	No. of trees	Vol. bd.ft.
17.0	9,634	5.2	4,403	14.7	10,443	3.8	2,072	13.7	8,840

With the aid of ERA labor, all the data on the 7,000 trees on the Pringle Falls method of cutting plots were transferred to individual cards. Stand and stock tables by diameters and Keen's tree classes were constructed for the virgin stand and for the cut trees and reserve stand for the economic and silvicultural marking on each of the seven plots. A report describing these plots and their treatment is being written by McKay.

Rocky Mountain

Stand Improvement

Preliminary data from twelve thinning plots established in 1933, based on only five years growth lodgepole pine stands averaging approximately 40 years of age at time of thinning, indicate that thinning stimulated growth immensely in the stands that had been suppressed, but not in stands that made more or less normal growth. In dense stands where the average diameter was about one inch, the increase in both height and diameter growth over the unthinned stands was marked.

Where the average diameter was approximately three inches the increase over the check plot was not so marked in diameter growth and height growth was less than that made on the check plot. Thinned stands with an average diameter of five inches at 40 years increased but little in diameter as compared to check plots and made much less height growth than the trees on the check plots. Practically no mortality occurred on these thinned plots in the five years since thinning.

Harvest cuttings

Analysis of inventory data from a series of lodgepole pine methods of cutting plots on the Fraser Experimental Forest indicates that a total of 1,475,000 feet B.M. (Scribner) in trees 9.6" d.b.h. and larger will be cut on the 165 acres of plots plus isolation strips. Of this Engelmann spruce will make up 8 percent and alpine fir slightly less than 2 percent.

Logging is scheduled for 1940 either by the usual timber sale, closely supervised by the experiment station, or by Government logging and sale of products at the roadside.

Southern

Silvics

Forest Biology of Horn Island. A paper entitled "Notes on the Forest Biology of Horn Island, Mississippi," by L. J. Pessin and T. D. Burleigh, was submitted to the Louisiana State University museum to be published as an occasional paper. The island, about 13 miles southeast to Biloxi, Mississippi, contains fine stands of slash pine of different ages from seedlings of the current seed crop to trees with a d.b.h. of more than 24 inches. Many of the trees on the west end of the island are buried by sand dunes to the crown (some sixty feet), but this apparently has no marked injurious effect since the crowns seem to be growing normally and producing heavy crops of cones. In the interior, where no fires have occurred for at least two decades, slash pine reproduction is abundant and follows closely the depressions between dunes. On the elevated dunes pines as a rule are scarce. There are apparently very few rodents on the island and the birds which are known to destroy the pine seed crops on the mainland have not been seen on the island. This may account for the magnificent stands of slash pine. Of interest too is the fact that live oaks, which are abundant on the neighboring islands, are for some reason very scarce on Horn Island.

Nutrient Deficiencies. A study of the responses of young pine seedlings to deficiencies of mineral nutrients has been completed and the data analyzed. Sand cultures were employed in which were grown young seedlings of longleaf, slash, loblolly, and shortleaf pines. These sand cultures were supplied with nutrient solutions from which various mineral elements were omitted. The results showed that a nitrogen deficiency was most injurious to the growth of all four species, while the phosphorus deficiency showed the least injurious effects, and sulphur deficiency was injurious only to shortleaf pine. The nitrogen deficiency was particularly injurious to needle development. In the cultures lacking nitrogen, all but the longleaf pines failed to develop fascicled needles, and the longleaf pine needles were considerably shorter than in the other cultures. Different recognizable color symptoms were also obtained for most of the nutrient deficiencies.

Longleaf Pine Competition Studies. A study of the effect of the vegetative ground cover on longleaf pine seedlings was recently completed. The results of this study showed that grasses, particularly Andropogon scoparius, grown in containers together with longleaf pine seedlings considerably retarded the growth of the pines. When, however, the pine seedlings were grown by themselves (without grasses), the growth of the pines was nearly twice as great as when grown together with the grasses. When the grass tops were removed by clipping or by burning (ashes allowed to fall back into the container) the growth of the pines was greatly stimulated. The data indicate that competition between grasses and longleaf pine seedlings on the relatively infertile Gulf Coastal Plain soils is not only for moisture but also to a large degree for mineral nutrients.

Stand Improvement

Results of Pruning Small Longleaf Pines. A tabulation of the average 2-year growth of small check and pruned longleaf pines on the Harrison Experimental Forest is given below. The 150 open-grown saplings in the study were divided into 75 pairs in 1937, matched as closely as possible according to d.b.h., height, and length and width of crown. One tree of each pair was then pruned and the other left unpruned as a check. Three degrees of pruning were used: to 50 percent, to 67 percent, and to 100 percent of total height, respectively. Since five 1/2-inch d.b.h. classes were used, each average in the following table is based on 5 trees.

D.B.H. class in 1937	Average Growth in 2 Years (1937-39)											
	Prune to 50% of height		Check		Prune to 67% of height		Check		Prune to 100% of height		Check	
	D.B.H.	Hgt.	D.B.H.	Hgt.	D.B.H.	Hgt.	D.B.H.	Hgt.	D.B.H.	Hgt.	D.B.H.	Hgt.
<u>Inches</u>	<u>In.</u>	<u>Ft.</u>	<u>In.</u>	<u>Ft.</u>	<u>In.</u>	<u>Ft.</u>	<u>In.</u>	<u>Ft.</u>	<u>In.</u>	<u>Ft.</u>	<u>In.</u>	<u>Ft.</u>
0.6 - 1.0	1.04	6.8	1.04	6.3	0.98	5.6	1.10	6.2	1.10	5.6	1.12	6.4
1.1 - 1.5	0.98	6.0	1.04	6.4	0.84	5.7	1.04	6.9	0.65	5.0	0.90	5.3
1.6 - 2.0	1.08	6.4	0.96	6.2	0.74	6.1	1.06	6.6	0.76	6.2	0.98	6.1
2.1 - 2.5	1.00	6.3	0.96	6.8	0.62	6.2	0.92	6.7	0.42	5.9	1.12	7.4
2.6 - 3.0	0.92	6.7	1.04	7.1	0.72	6.4	1.04	5.7	0.22	5.5	1.08	6.9

Pruning to 50 percent of the total height has evidently had no consistent or appreciable effect on either diameter or height growth. Pruning to 67 percent of the total height has lowered the height growth only about 6 percent, on the average, but has lowered the diameter growth about 25 percent. Pruning all of the branches has lowered the height growth only about 4 percent for trees up to 2 inches d.b.h., but about 20 percent for larger trees. Under the same conditions, diameter growth has been virtually unaffected in 0.6 - 1.0-inch trees, but reduced about 25 percent in 1.1 - 2.0-inch trees, and reduced about 71 percent in 2.1 - 3.0-inch trees.

On the basis of these figures, the most practicable time to start pruning small, open-grown longleaf pines would be when they are about 2.6 - 3.0 inches d.b.h., and about 15 - 16 feet high. At this size the trees could be pruned to 50 percent of their total height, which is just about as far as a man can reach with a hand-saw, and the diameter and height growth would not be appreciably affected. This pruning would ordinarily remove about one-third of the live crown. Time studies have shown that for this size of tree and degree of pruning it will take about 1 hour for a man to prune 100 trees. Studies of the results of pruning larger trees, however, may indicate the desirability of deferring the first pruning until the trees are larger than 3 inches d.b.h.

Harvest Cuttings

Longleaf Pine Reproduction... An attempt to stimulate height growth of longleaf pine seedlings by periodic burning was initiated in 1932 at Bogalusa, La. The seedlings dated from the 1920 seed crop but after 12 years were still in the "grass" stage. Four thousand seedlings, distributed equally between two pairs of plots, were classified by type of bud (flat or pointed), and the height of each was measured to the nearest tenth foot. One plot of each pair was burned over in 1932, 1934, and 1936. The surviving seedlings on all four plots were remeasured in 1938.

An analysis of the data shows the following results: Seedlings with pointed buds averaged 0.72 foot in height growth in 6 years while the flatbud seedlings grew only 0.07 foot. Periodic burning had no significant effect upon the height growth of pointed-bud seedlings, but produced a significant increase of 0.03 foot in the height growth of the flat-bud seedlings. Seedlings with pointed buds appeared to be particularly susceptible to fire injury and consequent loss of height growth where 0.3 foot high. The effect of burning upon mortality was not conclusive. Mortality was 33 percent on the protected plots and 47 percent on the burned plots, but there was great variation within treatments and this difference was not significant. The seedlings with pointed buds had a survival of 75 percent, which was significantly better than the 58 percent for flat-bud seedlings.

Rot in Loblolly Pines Left after Cutting. Increment cores taken from 246 loblolly pines on the San Jacinto Experimental Forest, left after moderately heavy selection cuttings and ranging from 4 to 14 inches d.b.h., indicated that 10.6 percent had center rot. There was no outward indication of decay in these trees. The rot was generally confined to an inch or two at the center, although a few trees showed a much more advanced development of the decay.

Southwestern

Stand Improvement

The value of uniform thinnings in pole stands of ponderosa pine in the Southwest has been questioned for several years. A series of plots established in a stand improvement area on the Gila in 1933, which included both thinned and unthinned 30- to 40-year old stands, were remeasured in 1938. During this period, the average diameter growth of trees above 7 inches b.h. in the thinned stands was .48 inch and in the unthinned stands .42 inch. For trees 7 inches b.h. and under the average diameter growth was .26 inch and .14 inch respectively. The greater difference in diameter growth of the smaller trees is ascribed to the fact that in the unthinned stands there were a large number of slow-growing suppressed trees. In the thinned stands trees of this character had, of course, been removed; hence, the average diameter growth of the remaining trees would naturally tend to be greater but not necessarily due to reduced competition. The difference in the diameter growth of the larger trees, although much less than for the smaller trees, is also probably primarily due to the influence of a number of unthrifty trees in the unthinned stands. However, even in the thinned plots, from which practically all unthrifty trees had been removed but among which the number of large trees (8 inches b.h. and over) left varied from 30 to 152 per acre, the average diameter growth of these trees differed very little. At the same time differences in the numbers of these trees had no material effect on the average diameter growth of the other, smaller, trees.

Earlier experiments at Fort Valley and on the Prescott had shown that the smaller trees respond much more to thinning than do the larger ones. Dominants respond relatively little because they are already growing at a good rate. These observations led to the abandonment of uniform thinnings in extensive stand improvement and the substitution of a crop tree method. Findings on the Gila plots justify this decision more than ever.

Since acceleration in diameter growth of crop trees is almost entirely dependent on the removal of immediately adjacent and competing trees, this, and not the leaving of a definite number

of crop trees per acre, should be the guiding principle in making thinnings in pole stands. In other words, the aim should be to leave as many crop trees as the proper silvicultural treatment of the stands will allow.

Silvics

Effects of watering pinon trees in dry period of early summer.

Watering of pinon trees was tested at the Walnut Canyon plot near Flagstaff, Arizona, in the dry period of early summer from May to July 1938. Ten pairs, one of which was discarded, of mature pinon trees bearing immature cones were selected within a 5-acre plot. The two paired trees were matched as to size and shape but not as to number of immature cones. One of each pair selected at random was watered and the other left as a control.

Over an area with a radius of 10 feet from the trunk the equivalent of 5 inches of rain was added in portions of 1 inch each at intervals during the period from May 25 to July 26.

The cone crop at the plot was light and scarcely of commercial importance, and the number of good seeds or nuts per cone was low. In every pair the control tree had a higher average number of good nuts per cone than the corresponding watered tree. Average number of good nuts per cone was 3.99 for the watered trees and 5.93 for the controls. The 9 control trees had an average of 1.94 more good nuts per cone than the 9 paired, watered trees, but the range extended from .02 to 4.33 nuts in the different pairs. As the standard error is .54 nuts, the difference is highly significant.

It is not yet known whether watering affected the number of cones, if any, which will mature in 1940, primordia of which were formed late in the summer of 1938.

Differences in vegetative growth were compared from the following measurements of growth in 1938 on the uppermost branch of each tree: lengths of first and second internodes, length of needles on first and second internodes, length of main bud, and number of buds in cluster. While in all these cases average values for watered trees were slightly greater than for untreated trees, these differences were very slight and not statistically significant.

FOREST PRODUCTS

FOREST PRODUCTS STATISTICS

Northern Rocky Mountain

Census. The annual census of lumber production is nearing completion with reports having been received from 435 of the 500 sawmills canvassed. The 65 delinquent mills are mostly small, only 25 of the number having an annual production of 200 M feet or over.

Lumber Requirements. During February and March, reports on urban requirements, rural non-farm requirements, and the requirements of city governments in the northern Rocky Mountain region were prepared by Whitney in rough draft form, and they are now being reviewed.

In the urban lumber requirements study, data obtained by sampling over 70 percent of the total urban area of the region formed a sound basis for separate calculations indicating the average annual requirements for residential construction, private garage construction, other nonresidential construction, and for building repairs.

Pacific Northwest

Statistics. The small sawmills of the Douglas fir region of Oregon and Washington are becoming an increasingly important factor in the lumbering industry of this region. Because of the simplicity of their organization the present tendency is toward the smaller units rather than the large complex operations of past years.

The following tabulation shows the number of mills not exceeding 50 M feet daily capacity, also their production and percent of region production for representative years.

<u>Year</u>	<u>No. of small mills</u>	<u>Lumber production</u> <u>M feet</u>	<u>Percent of regional production</u> <u>Percent</u>
1925	398	708,570	7.48
1929	716	1,101,774	10.74
1931	374	443,615	8.24
1937	709	1,150,075	16.27

Lumber Census. To date 1,407 acceptable census schedules have been sent to Washington. There are still about 400 companies to be heard from. Past experience suggests that many of these delinquent companies will have to be contacted to get the desired information.

TIMBER HARVESTING AND CONVERSION

Pacific Northwest

Conversion

A recent analysis indicates the relative decrease in variable milling cost to be expected under a light cut (40-50 percent volume removal). Two sources of data showed a reduction in the weighted average variable milling cost of 5 percent and 8 percent, respectively. This is another advantage of the lighter cut which has not been emphasized in our studies, mainly because the basic data have not been available.

WOOD PRESERVATION

Pacific Northwest

The annual questionnaires to obtain information on new arsenic paste-treated telephone lines were returned by the Forest Supervisors. A report covering these lines has been prepared and copies will be forwarded to the Regional Office and the Forest Products Laboratory. An inspection of the arsenic paste service test line near Mineral, Washington, was made. Of the 100 poles in this test, 28 showed rot. However, none were in need of replacement. Although it is too early to draw any conclusions as to the efficacy of the paste treatment, it would seem that the life of the poles is prolonged to a certain degree. Several western red cedar poles which had been treated with granular arsenic were recently removed from the Cowlitz line on the Columbia National Forest. A brief inspection of these poles seemed to indicate that the granules were effective only where they were in actual contact with the pole and not always there.

FOREST AND RANGE INFLUENCES

FLOOD CONTROL SURVEYS

Allegheny

Preliminary Examinations

The final draft of the report for the Passaic River is now under consideration by the Field Working Committee. Preliminary examination of the Pequest River watershed in New Jersey has begun; the flood control problem is localized in an area of muck land intensively used for agriculture and subject to overflow during the growing season.

Mesavage is preparing a short report on the value of watershed management in protecting water supplies from contamination and pollution. Data as to water yield per square mile of watershed, and instances of flood and debris damage resulting from denudation of watersheds, are being incorporated.

Watershed Surveys.

Work on our silt sampler was finished, and the sampler will be tested on the Youghiogheny Survey in the near future. A new snow sampler, designed for use under Eastern conditions, was tried with considerable success on this survey. The value of information on water content of snow under different covers, in determining possible flood conditions, is apparent.

The Youghiogheny Survey was visited by the Washington Coordinating Committee. Compilation of the physical characteristics of the forest area has been completed. Several watersheds were selected for the study of snow cover, frost penetration, and soil moisture, as a means of determining the extent of critical flood-producing areas. Streamflow and precipitation data are being analyzed to show the effect of the tributaries upon the stream hydrograph.

A major problem on this survey is the evaluation of headwaters damages which, with downstream damages, must justify the remedial measures we propose. The attempt to solve this problem immediately poses another: If damages are extensive enough to justify a control program, to what extent will these damages be reduced by improving or altering cover conditions? The following statement by one of the FCS men expresses our present thought on this point: "I believe that we should be very cautious about working up such an estimate because after obtaining these figures

it will be all too easy to forget the very doubtful basis on which they were predicated and deduce conclusions which might not be justifiable. Armed with guesses as to the percent effectiveness of various areas we could make a guess as to how much water the best areas would hold, and then proceed to multiply this number by each of the percentage numbers, carrying the calculations down to several significant figures, and make a very imposing looking presentation of the technical and economic value of vegetative cover which really had no factual basis at all. Personally I would prefer to make our land management recommendations in more generalized form."

Central States

Watershed Surveys

St. Francis River. The study to determine flood damages has been practically completed. At the March meeting of the Field Working Committee it was decided that the party would make a complete study of the Little St. Francois River watershed, and work out a practically complete report for this watershed. It had not as yet been determined whether or not an interim report will be prepared if it appears that a large block of marginal land may be secured at a reasonable price for reforestation.

Arrangements were made to secure runoff and erosion data from the Erosion Experiment Station at Bothany, Missouri. Arrangements were also made to make runoff and erosion studies with the rainmaker. It is planned to make runs on sixty-four plots (i.e., thirty-two in duplicate).

March rains have produced floods on many tributaries and on the St. Francis itself. The initiation of sampling for silt has demonstrated that the tributaries Wolf Creek and the Little St. Francois (comprising the best agricultural land at the head of the watershed), and to a lesser extent, Otter Creek, are the major silt producers. The soils on the Wolf and Little St. Francois contain much Tilsit silt loam. Other tributaries produce lesser turbidity, quantities of sand, and cherty gravel.

Muskingum Watershed. At the March meeting it was brought out that good progress is being made on the preliminary estimate of flood damages for the entire watershed, and that such estimate has been largely completed for Killbuck Creek. It appears that a large part of the field work on Killbuck Creek has been completed. It was brought out at this meeting that considerable data were needed as a basis for estimating the benefits that may be secured from proposed flood control measures.

Northeastern

Watershed Surveys

On the Merrimack survey an investigation is being made of both the long time and the immediate measures which may prove applicable on the watershed to help regulate the flood flows in the basin. A general study of the hydrology of the basin and the occurrence of floods has pointed to the areas which contribute most of its flood waters. Since floods are built up by the accumulation of water from flood source areas, the matter of timing the discharge of flood waters from each of these areas is of utmost importance. No data are available concerning rainfall or runoff on small headwaters areas, although recording stream gage records are obtainable from the U. S. Geological Survey at eight stations on the principal tributaries of the Merrimack. In order to get some information concerning the way the flood discharge builds up, fourteen staff gages have been installed in the headwaters of the Smith River, a small tributary with a drainage area of approximately 88 square miles, which has a U. S. Geological Survey recording gage installed near the mouth. These staff gages are to be read at frequent intervals during the spring freshet by local observers in order to obtain stage hydrographs for the various parts of the drainage. A recording rain gage has been installed to provide a continuous record of precipitation. A continuous record will also be obtained showing the progress of the snow melt during the break-up. Later in the spring similar observations of rainfall and runoff will be made for a storm which is not accompanied by melting snow. It is hoped that these observations will provide some of the much needed information concerning the way in which flood waters accumulate on the watershed to form peaks on the tributaries.

Because of the character of the topography in the Merrimack basin there are numerous sites available for small pond storage. The number of these sites makes the cost of transit and stadia topographic surveys prohibitive. A more rapid method is being devised to secure sufficiently accurate information concerning the character and topography of the dam site and the volume of the storage available. The method which is to be tried will require a 2-man crew. Each man will be equipped with a plane table, alidade, Abney level, compass, and Paulin Type A-1 altimeter. One man, a geologist, will map and investigate the geology of the dam site and plot a barometric correction curve from the stationary altimeter. The second man, an engineer, will prepare a contour map of the storage basin using an enlarged U.S.G.S. sheet or aerial photo for a base map, obtaining elevations with his altimeter. He will also make an appraisal of property values in the reservoir area. A simplified method of handling the analysis of these pond possibilities in the office is in process of development.

A reconnaissance of the watershed indicates that most of the sediment carried by the streams in the basin comes from bank erosion. All of the eroded banks have been located on maps and some of these areas are to be studied in further detail to determine whether any control measures are technically and economically feasible. A complete investigation of any accelerated sedimentation is to be made in the spring.

In order to complete the check-up of all of the possibilities for immediate flood control measures, the use of contour furrows on abandoned brush land for flood storage is being checked.

The appraisal of damages and the evaluation of benefits which may accrue through reduction in these damages is one of the most important and difficult phases of the investigation. In the downstream reaches of the stream, damage surveys have been made and stage-damage-relationships established in surveys of the U. S. Army Engineers. In order to locate all flood contributing areas, a reconnaissance survey has been made of local damages to find where the most important local damage centers are located. Now a more detailed appraisal of local damages is being carried on in those areas which may be affected by the development of a headwaters control program.

Pacific Northwest

Preliminary Examinations

The preliminary flood control reports for the Nooksack River, Washington, and Tanana River, Alaska, have been approved.

Inquiry was made of several municipalities in northwestern Oregon to ascertain the value of lands for watershed purposes. Areas purchased for right-of-way, intake, or reservoir sites were excluded. It was found that prices paid for cut-over lands to be used as watersheds ranged from \$2.65 to \$16.50 per acre, with an average of about \$8 per acre. The water yield averaged 3.5 acre feet and the cost per acre foot was approximately \$2.25.

Permanent Records

There was need for flood control data compiled in a compact and portable form that would make it readily available for conferences and instant use. To meet this need two notebooks were made up, one for Oregon and one for Washington, containing the forest cover type maps by drainages and a one-page summary of statistics regarding rainfall, streamflow, flood flows, flood damage, flood frequencies, authorized projects, and bibliography.

EFFECT OF COVER ON CLIMATE

Lake States

Shelterbelts

Effect of Shelterbelts on Snowdrift Formation. How the position of snowdrifts can be controlled by varying the pattern of shelterbelts is the result of a study that has just been completed by Stoeckeler and Dortignac.

In view of the fact that recent proposals to plant "living snowfences" of trees and shrubs along highways have attracted favorable interest among conservationists, wildlife lovers, hunters, advocates of roadside beautification, and highway engineers, these results may become very useful.

The most effective method of causing snow to pile up within the shelterbelt, rather than to drift on the lee side, is to establish a dense row of shrubs eight or more feet in height on the windward side of the trees. Dense-growing rows of shrubs planted about 100 feet from roads and highways act as snow traps and will prevent blocking of the highways by snowdrifts.

The study also brought out that shelterbelts in the plains region are greatly benefited by the increased moisture supply resulting from trapping of snow. Tall trees with few or no branches near the ground allow the snow to swirl through the shelterbelts and be deposited in a broad, thin sheet for a long distance to leeward, if there are no low dense shrubs to cause a slackening of the wind near the ground.

Shelterbelts of a pattern that will cause deep snowdrifts near the belt increase soil moisture from fall to spring in or near the belt the equivalent of 5 to 10 inches of rainfall.

Shelterbelt Influence on Crop Yields. The station is undertaking a series of intensive experiments to determine the effect of shelterbelts on the yield of corn and small grains in the Prairie States. By starting the studies on fields that are not at present protected by belts, it will be possible to determine the yield capacities of various sections of the field; then, when the shelterbelts have begun to grow and their effect becomes evident, it will be possible, by the method of covariance, to correct the observed values for inherent fertility differences.

INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW

Rocky Mountain

Forest. The season's snow surveys were initiated on April 1 for measurement of snow depths and densities on lodgepole pine cutting plots in the Fraser Experimental Forest. The first snow survey showed the following comparison with last year's snow storage at the same time of year:

<u>Year</u>	<u>Average depth inches</u>	<u>Average water content inches</u>	<u>Density %</u>
1938	32	7.2	22.4
1939	25	6.4	25.9

The greater relative density this year is a result of settling which occurred during an unusually warm period in early spring.

Grassland. Completion of analysis of "rainmaker" plot data has brought out fairly definite conclusions regarding the influence of plant cover density on run-off and erosion. In the bunchgrass (*Festuca*) type on alluvial valley soils, run-off is strongly correlated with plant density, decreasing as the plant cover increases in density. Erosion, however, shows a weaker relation and positive in direction. Bunchgrass on mountain slopes in coarse granitic soil appears to have very little influence on run-off and not much more on erosion. A similar result was found for weed cover on abandoned fields.

These findings seem conclusive for the limited range of plant-cover densities studied. Extension of experiments into denser cover conditions will be required in order to establish absolute trends.

Southwestern

Water Supply

Influences investigations of the Southwestern Station, which are centered on the Salt River watershed, have shown (1) in average, by far the greater part of the total annual discharge of Salt River occurs in winter and over 90 percent of the flow results from winter precipitation; (2) winter precipitation at low and medium elevations occurs as low-intensity rainfall or snow that soon melts and snow usually accumulates on the higher mountains; (3) nearly all rain and

snow water at low and medium elevations sinks into the ground where it falls or before reaching some permanent stream; (4) accumulated snow in the high mountains melts out mainly from mid-March through April, and save for sheltered, scattered drifts, usually disappears early in May; and (5) the distribution of nearly 55 percent of the average annual precipitation and more than 79 percent of the average annual discharge of Salt River, or that part occurring during the principal flow months in winter, is, for the period 1902-36, as follows:

<u>Month</u>	<u>Precipitation</u>	<u>Stream flow</u>
	<u>Percent</u>	<u>Percent</u>
November	7.70	4.23
December	10.07	6.43
January	9.62	9.19
February	11.06	16.29
March	8.78	18.64
April	5.28	17.49
May	<u>2.37</u>	<u>7.40</u>
Total	54.88	79.67

From these facts it will be seen that on Salt River and similar watersheds winter precipitation is the real source of stream flow and that precipitation water reaches streams through the ground-water route. Hence, for precipitation to be effective, the ground of drained slopes which has become dry during the fall season dry period must first be wet through, and for it to continue to be most effective, the interval between storms must be so short as to prevent excessive evaporation of soil moisture. Also, in average, the effect of rain and snow that soon melts becomes cumulative during the winter as deeper and deeper soil bodies become wet through and begin yielding water; and that as precipitation declines in spring, melting snow on the high mountains contributes to stream flow during the low precipitation months of April and May.

It is perfectly natural to consider precipitation in seeking an answer to stream-flow conditions. Records for the past 3 months of 1939 show no unusual deficiency in the amount of rainfall. In fact, the Weather Bureau considers the snowfall for February to be the greatest since 1913, hence the amount of precipitation during January, February, and March must not be the reason

for lack of any temporary freshets and protracted high flows which contribute principally to reservoir storage.

When conditions during the past winter are compared with the 35-year averages of precipitation on Salt River watershed and flow of Salt River, given above, two conditions that must have influenced stream flow are outstanding, (1) severe drought during the latter part of 1938 and (2) long intervals between the effective storms of 1939. The records on experimental watersheds also substantiate such conclusions. The first storm of December 1938 ended one of the longest, if not the longest, rainless period known in Arizona--about 90 days. The water from this and some succeeding storms was absorbed by the very dry ground. Storms following dry-out periods did little more than replace the moisture lost from the soil in the intervals between rains. Several times since early February the stage has been set for high flows. Drained slopes were wet, were giving off percolation water, but storms failed to come or the amount of rainfall was too small to be effective. The February snowfall was high; it even extended to low elevations. But here and at medium elevations, snow seemed to contribute less to stream flow than rain would have because of low temperatures following storms and evaporation or sublimation of snow. Snow accumulated at high elevations, but here also most of it seemed to have been lost through sublimation during cold dry weather.

STABILIZATION OF SOILS

Appalachian

Roads

Wood and Swofford, C.C.C. men from Region 8, reported several points of interest that have appeared recently in their road bank fixation work on national forests.

Staked weed and litter mulches are generally proving the most satisfactory means of back slope fixation so far as application and control are concerned. Outstanding failures have resulted where project superintendents and ERA foremen have attempted to reduce the amount of labor expended to an unprofitable minimum. For example, in one ranger district hardwood litter was applied with pegs on a considerable section of road without the use of top brush to hold it in place. This job appeared to the foreman to be in good shape because at the time the litter was applied it was moist and apparently laid in place well. After the litter dried out completely

on exposure to the sun, winds blew it off the bank completely and the work had to be done over.

Considerable loss of work has also resulted through frost action on masonry down-spouts and culverts on fills. The difficulty in this case was due to the use of structures too small to stand stress due to winter temperatures.

It has been found that weed mulches put on early last October produced an abundant germination of fall species. These fall seedlings are now starting rapid growth. Seedlings of spring germinating species are now also abundant. Actual counts will be reported after more of the seed have a chance to germinate.

In general, it is found that making the back slopes too smooth before applying mulches is a mistake. The trend is toward leaving the banks in a more loosened and roughened condition. Long steep banks are being tested as contour benches on which top soil can be dropped from above to provide a loose material containing some good soil for plant growth. This loose soil is held by pegs, litter, and mulch.

It becomes more and more apparent that specific recommendations cannot be applied to all localities because of materials available and the difference in soil composition. Establishing natural seeding areas by use of well-fastened mulches appears to have as broad an application as any one method yet devised. Small applications of fertilizers to favor seedling growth are now being tested, together with seeding different grass and other species in the mulches.

Intermountain

Watersheds

Preliminary tests with the use of tensiometers for measuring soil moisture content have been made during the last field season and in the laboratory during the winter on coarse granitic soils from the Boise National Forest in southern Idaho. The tensiometer used is the type "C" described by Richards and coworkers.^{1/}

At the Arrowrock Substation several tensiometers were installed at various depths and were read daily until soil became so dry that the tensiometers failed to function.

^{1/} Further developments on apparatus for field moisture studies by L. A. Richards, M. B. Russell, and O. R. Neal. Soil Sci. Proc. 1937, pp. 55-64.

On another area within 300 yards of the tensionometers a soil moisture study was made to determine the variability of soil moisture as a basis for determining a soil moisture sampling system.

The results of both tests have been compared mostly to discover the relation between tensionometer readings and soil moisture content. Inasmuch as the samples did not come from the same place and due to the variability in soil moisture over small areas, and also because the tensionometer depths did not correspond exactly with soil moisture sampling depths, a rough estimate is all that could be expected. A comparison of the soil moisture content and tensionometer readings from the depths which most nearly corresponded showed very close agreement considering the variables involved and showed the march of the soil moisture and fluctuations in moisture due to precipitation. These results seemed so encouraging that it was decided to make a more accurate test in the laboratory.

A battery of four tensionometers was set up so that whenever a tensionometer reading was made, the whole outfit could be placed on a balance and weighed to determine the soil moisture content. The soils used were duplicate samples from the Arrowrock Substation headquarters, and duplicate samples of the soil used to fill the Bannock Creek Substation lysimeters. These soils are both coarse-textured having about 30 percent of gravel and the remaining fraction being a sandy loam. The moisture equivalent values are 11.4 and 13.5 for the Bannock Creek and Arrowrock soils, respectively.

The relation of the tensionometer reading to the content for the Bannock Creek soil were shown in graphs. The curve obtained for the Arrowrock soil was almost identical except that accurate readings were not obtained after the soil got drier than 14 percent moisture.

These results indicate that the tensionometer is quite satisfactory for measuring moisture content within a certain range which for these soils was found to be from 12 or 14 to about 22 percent. For moisture contents higher than that range the tensionometer is not very sensitive and for those below it, the tensionometer sucked air in the cup and let the columns break. For these soils the mercury in the manometer would not seem to go above 500 mm. It is possible that with improved technique of installation or that if another type of cup were used, accurate readings could be made on soils with somewhat lower moisture content, but from the curve obtained on these soils it would seem impossible to increase the range so as to cover more than 3 or 4 percent less moisture than that obtained.

The results of this preliminary study seem to confirm those of Rogers ^{2/} in England who found a similar device quite accurate

^{2/} A soil moisture meter by W. S. Rogers, Jour. Agr. Sci., 35:326-343, 1935.

within a certain range. The lower limit varied with texture from about 14 percent in loam to about 21 percent moisture in heavy clay.

RANGE RESEARCH

GRAZING MANAGEMENT

Intermountain

Winter Range

Stockmen frequently object to range conservation because to them the term is associated with curtailment of livestock numbers, which they think is the equivalent of a decrease in financial income. On properly grazed winter ranges this is not the case because many beneficial results of conservative use accrue to the stockmen in increased vigor and condition of the animals.

Two flocks of sheep which at the Desert Branch Station alternate with each other in using the conservatively grazed experimental area and the heavily grazed open range show marked contrast in flesh and vigor. In the winter of 1937-38 random samples of sheep were weighed from herds "A" and "B". Herd "A" was placed on the conservatively grazed experimental range on January 12, 1938. By March 20, 1938, herd "A" was in better flesh by 10.5 pounds per head than herd "B" on the open range. In 1938-39 these two herds were reversed and herd "B" was placed on the experimental range on January 8, 1939. By February 20, 1939, herd "B" had wintered 8 pounds per head better than herd "A" on the heavily grazed general range. Owing to the greater abundance and better quality of forage which grew during the summer of 1938 both herds wintered in somewhat better flesh during 1938-39 than in 1937-38.

Pasture studies also indicate a close correlation between intensity of range use and condition of sheep (see table 1).

Table 1.- Change in sheep weights under three degrees of use.

Degree of use		1937-38	1938-39
	<u>Fall (November-December) 40-day period</u>		
Heavy		-0.32	-3.20
Moderate		+3.50	+1.83
Light		+7.42	+1.52
	<u>Winter (January-February) 40-day period</u>		
Heavy		-3.55	-1.98
Moderate		+2.80	+1.64
Light		+5.21	+2.16

During the fall period sheep under moderate grazing are maintained approximately 4 to 5 pounds per head heavier than those on ranges subjected to heavy use.

In the main, the effects on the sheep in the pastures are closely correlated with the intensity of use; however, sheep in small groups which are bothered time and again by coyotes frequently show greater loss in weight, or less gain, than those left undisturbed by predatory animals.

The greater vigor and better flesh condition of sheep which results from conservative grazing brings to the stockmen greater profit in heavier fleeces, greater lamb crops, less mortality, less outlay for supplemental feeds and less expense in trucking and feeding poor weak animals.

Utilization Standards

During the field season of 1938 at the Great Basin Branch Station, volume-height determinations were made for 23 important range forage species common to the summer range types of central Utah. These include 16 grasses and 7 broadleafed herbs. Four species were gathered in each of the oakbrush, aspen-fir, and spruce-fir zones; 5 were gathered in 2 of the 3 zones, and 14 gathered in only 1 of the 3 vegetational zones. Completed data regarding the broadleafed herbs are briefly discussed.

In general, volume-height tables are not as satisfactory for measuring utilization of broadleafed herbs as for grasses. The growth habit of broadleafed herbs tends to make it more difficult to prepare accurate volume-height tables and many species such as Osmorhiza obtusa, Lathyrus leucanthus, Vicia americana, and Mertensia leonardii are so tender that much of the herbage is trampled down rather than being fully consumed by livestock. These species, when trampled to the ground, soon dry and shatter, and thus make it difficult to measure utilization except immediately after being grazed. The half-spherical growth form of geranium and the rosette, or nearly rosette, growth habit of dandelion makes volume height tables difficult to prepare for these species, and when prepared, rather impractical to use.

Accurate volume-height relationship can be determined, however, for such species as Agastache urticifolia, Osmorhiza occidentalis, Ligusticum porteri, and other species having similar growth, if care is exercised in harvesting and sectioning the plants. However, the use of volume tables for arriving at the degree of use for these species may prove to require considerable interpretation. Under usual range conditions the leaves and fine branches are ordinarily taken first, leaving trimmed stems to half or two-thirds their original height. Under more severe grazing the stems are often utilized rather close to the ground. Thus, the intensity of grazing changes the volume-height relationship of these species and of similar ones, so greatly that this relationship may be highly erratic until the plants are grazed down to within about 6 inches of the ground, - a level below which there are but few leaves on these species. At the 6-inch level there is a difference of over 10 percent in volume removed for plants in the short (21 inches) and tall (37 inches) plant classes of Osmorhiza occidentalis harvested in 1938. There is a difference of about 16 percent for Ligusticum porteri and 7 percent for Agastache urticifolia in the volume of herbage removed when grazed to 6 inches between plants in the shortest and tallest height classes in which heights of plants ranged from 12 to 36 inches and 28 to 42 inches for the two species as listed.

Broadleafed herbs ordinarily are not regarded as key species, and accordingly it is usually thought that there is little need for making accurate determinations of the degree of use to which these plants have been subjected. On some range areas, however, broadleafed herbs often make up a considerable proportion of the forage and their maintenance in the composition is desirable in many cases. Furthermore, grazing use for this class of forage needs to be rather accurately measured in order to determine P.U. factors which will be reliable to use in determining grazing capacity of a range.

The variation in the volume of the plant removed when cut to different height levels is shown in table 1 for Osmorhiza occidentalis. (This species is given a high P.U. rating for summer range, usually about 70 to 75 percent.)

The application of volume height tables to field use rests primarily on two points: (a) Is the table as prepared representative of the species under field conditions? (b) Can various intensities of grazing use be grouped together and an average use determined? The values presented in table 1 indicate that average values are not reliable in all cases. If the top 6 inches were uniformly grazed from the same number of plants in each height class, leaving an average height of 24 inches, an actual utilization of 10.7 percent would be attained compared with 13.6 percent for 24 inches as shown by average for all plants. If 10 inches were uniformly taken, leaving the remnant plants an average of 20 inches in height, an actual utilization of 23.46 percent would be obtained whereas the table gives the very close agreement of 23.96 percent. Again beginning with the lowest height class suppose that plants in each height were uniformly grazed to 2, 26, 15, 30, and 25 inches, respectively. This would make an average height of 19.6 and would show an actual utilization ranging from 0 to 91.75 with an average of 30.35 in comparison with 25.27 as determined from the average values in the table.

Table 1.- Volume height table for Osmorhiza occidentalis showing the volume of the plant removed at different height levels for plants in various height classes.

Plant taken to: (inches)	Plant Height	21-24"	25-28"	29-32"	33-36"	37-40"	Average
	Percent of Volume Taken						
37						.00	.00
36						.27	.07
35						.54	.14
34					.00	1.63	.41
33					.86	2.74	.90
32					1.78	4.23	1.50
31				.00	2.83	5.74	2.14
30				.64	3.88	7.65	3.05
29				1.75	5.76	9.56	4.29
28				2.71	7.64	12.12	5.65
27				3.67	10.50	14.68	7.26
26			.00	5.80	13.38	17.79	9.32
25			1.06	7.87	15.77	20.90	11.40
24			2.18	10.25	18.15	24.15	13.60
23			4.97	12.70	20.97	27.42	16.18
22			7.76	15.05	23.79	30.83	18.78
21		.00	10.74	17.24	26.42	34.24	21.31
20		2.70	13.72	19.41	29.07	37.17	23.96
19		5.40	17.89	22.43	32.75	40.09	27.27
18		7.14	22.09	25.30	36.41	42.93	30.43
17		8.88	27.27	28.23	39.34	45.75	33.56
16		12.78	32.45	31.39	42.28	48.76	36.99
15		16.68	37.50	35.22	45.41	51.79	40.63
14		21.81	42.45	38.93	48.54	55.46	44.51
13		26.99	47.57	43.17	51.87	59.13	48.58
12		32.17	52.56	47.85	55.22	62.54	52.70
11		37.35	57.13	52.70	59.56	65.95	57.05
10		44.46	61.70	57.64	63.90	68.98	61.50
9		51.56	65.39	62.76	68.17	71.99	65.85
8		58.34	69.08	68.05	72.43	74.91	70.18*
7		65.12	72.77	72.81	76.03	77.83	74.20
6		70.80	76.46	77.03	79.63	81.35	78.14
5		76.44	80.23	80.96	82.90	84.87	81.93
4		81.94	83.98	84.88	86.16	87.96	85.59
3		87.44	87.91	88.71	89.68	91.04	89.31
2		91.75	91.84	92.71	93.20	94.12	92.97
1		96.06	95.93	96.43	96.60	97.20	96.56
0		100.00	100.00	100.00	100.00	100.00	100.00

* P.U. Rating

Actual grazing does not remove the herbage in a uniform manner. Leaves are frequently stripped from the fine branches leaving the central stems still standing. Thus, the height of a single plant is difficult to determine and actual utilization of a group of plants is often greatly distorted and different from the values that are based on uniform removal of the entire plant.

Northern Rocky Mountain

Utilization Standards

Effects of varying grazing intensities or other treatments over a large range area have been very difficult to express in definite terms, even after relative differences are clearly evident by observation. A reliable measuring stick is particularly needed in detecting trends before observation or other rough comparative measures heretofore used will serve the purpose in research.

Two methods aimed at objective and definite figures were tried in measuring utilization on cattle pastures grazed at varying intensities last season. The first of these was a survey on which measurements were made of grazed and ungrazed plants on about 700 plots by subtypes. From these measurements, a definite utilization figure has been obtained through a procedure using the height-percent volume relationship for each of three key species in six pastures, grazed at three intensities. Seven different subtypes are involved. Following is a summary of data for six cattle pastures (two replications) from this method by intensities and species:

	Utilization in percent		
	<u>Overgrazed</u>	<u>Moderately grazed</u>	<u>Lightly grazed</u>
Bluestem wheatgrass	95	53	64
Gamma grass	83	70	63
Niggerwool	91	76	81

Gamma grass is the only species that shows the expected relationship between intensities. There are apparent discrepancies between utilization by other species as well as within intensities. A fairly satisfactory reason can be advanced for each of these apparent discrepancies. In other words, we are not satisfied with the numerical values obtained last year but believe these discrepancies may be avoided by certain changes in the procedure when the job is repeated. The same method was used on sheep pastures where utilization within pastures has been extremely spotted, and where comparisons seemed nearly hopelessly complicated. Discrepancies have been noted there also but a way to minimize or

eliminate these now seems within our reach.

In the second method, utilization was also measured by the height-percent volume relationship, determined through the use of measurements on paired plots, half of which were protected through the season by removable hurdle panels. This method served to strengthen confidence in the height-percent volume method. However, so many complications were encountered in the paired plot arrangement that this approach seems out of the question for regular use. The first method in which measurements were made on plots all open to grazing is far more rapid and more promising. This method appears to have promise for administrative use after it is speeded up. The problem from a research angle now appears to be one of changing details of procedure in the plot survey method to provide better sampling and to eliminate mistakes in procedure, many of which are now recognized. It seems possible to get better as well as more rapid sampling with experience.

Lincoln Ellison spent a few days in Missoula recently going over preliminary data and analysis of a scheme for pasture comparisons based on a record of density on paired plots that he devised prior to his transfer from this station. Final evaluation of the method is not possible at this time. At worst, the method will provide an interesting contribution to the problem of making definite pasture comparisons after data for a year or two more are available.

Pacific Northwest

Utilization Standards

Results from two years investigation of sampling technique have yielded preliminary figures on the number of plots required to sample percent utilization of forage species when using the ocular-by-plot method developed by Pechanec and Pickford, or the measurement method developed by Lommasson and Jensen and adapted for use on sample plots by members of the Pacific Northwest Forest and Range Experiment Station. Data from 19 trials on 15 forage species are presented (table 1). The data were obtained on three experimental areas in the Blue Mountains, each of which was slightly more than a square mile in extent, and are therefore comparable to data that would be obtained on areas within national forest grazing allotments on which utilization of important forage species is considered key to the management of the allotments.

In sampling utilization, 100-square-foot circular plots were used within which the utilization of all plants of the species under consideration was estimated. For green fescue (Festuca viridula), and elk sedge (Carex geyeri) heights of grazed stubble were also measured, and the percent utilization of the species on each plot was determined by use of "form curves" developed by clipping studies of the species. The measurement method entailed obtaining stubble heights on approximately 20 plants per plot, determining the average stubble height of the grazed plants, and converting this average height to percent utilization of the grazed plants for each plot. This percent use figure was then multiplied by the percent of plants grazed to get the actual percent utilization for the species on each plot. With the ocular-by-plot method this utilization figure was obtained directly for each plot by estimating percentage removal on the basis of green weight. Estimates of percent utilization were checked by clipping herbage from adjacent plants, estimating the percentage removal, and comparing this estimate with the actual removal determined from weighing the clipped herbage. The ocular-by-plot method is perhaps twice as rapid considering both field and office requirements as is the measurement method.

Sampling intensity data presented in table 1 are based on an accuracy standard of 5 percent in estimating utilization; i.e., estimates of 35 percent to 45 percent are acceptable if the true figure is 40 percent. The table shows number of plots required to obtain utilization estimates to this limit of error when probability of error in excess of the limit is once in three trials and when it is once in twenty trials. The former may be adequate for ordinary range inspections; the latter for use on range research or other projects where more dependable data are desired.

In the studies to date, no species has been encountered that requires more than 50 plots to sample its percent utilization with a one to three probability of greater than 5 percent error. The data were obtained on parts of three different grazing allotments that were handled no differently than the entire allotments. Therefore, it can also be said that no species was grazed in so variable a manner that more than 50 plots were required. For this accuracy standard, all but four species required 36 plots or less to sample percent utilization. Grasses all required 36 plots or less and in the case of green fescue on evenly grazed cow range only 10 plots were needed. Two shrubs on sheep range, rose and snowberry, required less than 30 plots. The data would indicate that if a two to one chance of being within 5 percent is sufficient, 30 plots will give a good estimate for nearly any key species on areas at least one section in size. The field and office work using the ocular-by-plot method of this degree of accuracy should not require more than three hours to complete. The measurement method probably would require a day of field and office work.

If results are desired within 5 percent of the true figure 19 times out of 20, from 37 to 193 plots are required, with 100 plots probably being a safe number in the majority of cases.

Species	Average use with standard deviation	Number plots esti- mated	Number of plots required to sample percent utilization with probability of error greater than 5% occurring in	
			1 of 3 trials	1 of 20 trials
Carex geyeri*	20.8 \pm 23.3	100	22	85
Carex geyeri	20.8 \pm 24.2	100	23	98
Festuca viri- dula*	45.7 \pm 27.4	356	30	116
Festuca viri- dula	45.4 \pm 29.8	356	36	136
Festuca viri- dula* 1/	55.2 \pm 15.5	31	10	37
Stipa letter- mani	13.9 \pm 17.5	366	12	48
Stipa letter- mani	54.4 \pm 24.3	258	24	90
Sitanion hy- strix	29.4 \pm 19.9	113	16	61
Aconogonum phytolaccae- folium	11.8 \pm 18.2	294	13	50
Hieracium chapacanum	60.2 \pm 22.9	109	21	81
Lappula flor- ibunda	33.4 \pm 34.0	31	46	177
Ligusticum grayii	69.2 \pm 26.5	39	28	108
Lupinus leuc- ophyllus				
canescens	82.0 \pm 16.6	105	11	42
Lupinus spp.	31.8 \pm 35.4	36	50	193
Paeonia				
brownii	69.6 \pm 34.4	32	48	182
Pentstemon deustus	65.6 \pm 28.0	142	31	121
Senecio				
columbiana	11.7 \pm 19.7	101	15	59
Rosa. spp.	25.9 \pm 26.2	22	27	106
Symphoricar- pos spp.	19.0 \pm 25.9	107	27	104

* Estimates of utilization made by measuring stubble heights and converting average stubble height per plot to percent utilization

by referring to "form curves" constructed for the species. Utilization estimates of species unstarred were made by the ocular-by-plot method.

1/ Estimates of utilization made on cow range. All other species listed occurred on sheep range.

Rocky Mountain

Noxious Plant Control

In September 1936 prickly pear (Opuntia polyacantha) was removed from a series of one-acre plots near Briggsdale, Colorado by grubbing, railing (railroad rail), and blading with a road grader. Cactus plants were left on half of the grubbed plots and hauled off from the other half. Untreated plots were left as a check against the various treatments. The density (percent of ground cover) was recorded before and after treatment in 1936, and again in 1937 and 1938. The density of prickly pear in percent for the three years and for the different treatments are recorded below:

Treatment	Year		1937	1938
	1936			
	Before treatment	After treatment		
Cactus grubbed and left on plots	1.378	0.000	0.719	1.547
Cactus grubbed and removed from plots..	1.225	0.000	0.000	0.028
Cactus railed.	1.106	0.070	0.297	0.794
Cactus graded.	1.094	0.025	0.034	0.234
Untreated.	1.255	1.255	1.528	2.728

It is evident that grubbing, grading, and railing were successful in the order named (see 1936 column). Removal of cactus following grubbing gave best results. A gradual increase of cactus on all areas is apparent, possibly a result of more favorable climatic conditions in 1937 and 1938. Careful field examination indicates that most of the cactus appearing on the grubbed and removed treatment is the result of migration by seeds from surrounding areas.

The data from this experiment will be analyzed to show the effects of the various treatments on grasses, weeds, and browse species; on grazing capacity; and the relation of cost to the results obtained. Observations will be continued for a number of years.

Southwestern

Noxious Plant Control

Velvet mesquite (Prosopis velutina) is generally regarded as valuable browse for livestock, particularly during droughts and when other feed is scarce; however, because of its rapid spread in recent years many stockmen have expressed concern principally for the following reasons:

1. Increase of mesquite is accompanied by a decrease in the more valuable perennial forage grasses.
2. In dense stands it is extremely difficult to gather or move livestock for roundup or to secure and treat sick animals, especially screw worm cases.
3. Cutting the mesquite for fuel or posts commonly results in an impenetrable thicket of sprout regrowth from the stumps.

The control of mesquite is considered to be an important problem in the Southwest and has received some attention from the State agricultural experiment stations. Preliminary studies on the control of velvet mesquite at the Santa Rita Experimental Range indicate the need for more specific information on treatments which are not only effective in killing the plant but economical in application. This preliminary work was done chiefly with kerosene applied to stumps and trees. Contrary to the findings of the agricultural experiment stations, our results have been rather disappointing. Examination of the accompanying table reveals that none of the treatments were effective in killing either mature trees or stumps when applied in September, November, or January.

During 1938, treatments similar to those outlined in the table have been continued at 90-day intervals including tests made at the reported favorable time of year. Data on the effect of these treatments have not as yet been secured; however, observations would seem to reveal that Diesel oil 270+API appears to be more effective than kerosene.

These preliminary investigations, although largely negative in results, have, in addition to indicating the need for further intensive study, provided the basis for a new series of treatments which it is hoped can be inaugurated during 1939.

Effects of kerosene as applied to mesquite stumps and trees. (Observed 9/16/38)

Tag numbers on trees or stumps	Treatment	Date	No. of trees treated			Character of regrowth ¹			Apparent kill ² /Per-cent	Actual kill ³ /Per-cent
			Below 2"	2"-4"	Above 4"	Poor	Fair	Vigorous		
1-10	1/2 pt. kerosene per stump	9/24/37			10		2	6		20
11-20	1 pt. kerosene per stump	9/24/37			10		1	7		20
21-30	1 pt. kerosene per stump followed by burning	9/24/37		2	8		4	3		10
31-40	1 pt. kerosene per tree	9/24/37		7	3	2	6	2	75	10
41-50	1/2 pt. kerosene per stump	11/24/37			10		2	8		0
51-60	1 pt. kerosene per stump	11/24/37			10			10		0
61-70	1 pt. kerosene per stump followed by burning	11/24/37			10			9		0
71-80	1 pt. kerosene per tree	11/24/37		5	5		1	4	72½	10
81-90	1/2 pt. kerosene per stump	1/24/38		1	9		3	6		10
91-100	1 pt. kerosene per stump	1/24/38			10	1	3	2		40
101-110	1 pt. kerosene per stump followed by burning	1/24/38			10		3	4		20
111-120	1 pt. kerosene per tree	1/24/38	1	3	6	1	4	5	62½	0

- 1/ Character of regrowth: Poor - 1 or 2 basal shoots, not over 12" long; fair - 3 or 4 basal shoots, not over 24" long; vigorous - numerous basal shoots over 18", usually 3' or more.
- 2/ Apparent kill percent means kill back to stem base (in case trees only).
- 3/ Actual kill percent means dead.

Utilization Standards

During formation of tentative utilization standards for southwestern ranges, studies have centered on a few principal species that may be employed as utilization indicators on the national forests of the region. From a sifting of all available data and the collection of new data when possible, proper utilization has been defined for each of the primary key species in terms of stubble height, flower stalks left, and percentage of volume taken both for ranges in good condition and for deteriorated range or steep slopes.

The accompanying table presents the first condensed summary of this information which in the past has been issued piecemeal and in more detail through periodic research notes. Changes that may be noted between this and earlier releases are due to revisions that have been indicated by field check or additional data.

The wide difference in many species between present proper use factor and the percent of herbage volume that may be taken according to tentative standards is noteworthy. Laboratory tests now in progress indicate that for all practical purposes percent utilization by weight is the same as percent utilization by volume, so it appears that the differences shown are due to lack of data in the past on grass taper and the concentration of herbage near the root crown.

SATISFACTORY UTILIZATION OF PRIMARY KEY SPECIES

Rank 1	Name	Sym- bol	Proper Utilization Defined (End of Season)						Present proper use factor ³	
			Range in Good Condition			Deteriorated Range or Steep Slopes			Cattle Percent	Sheep Perc.
			Stub- ble height inches	Flower- stalks left Percent	Volume taken ² Percent	Stub- ble height inches	Flower- stalks left Percent	Volume taken ² Percent		
1.	Blue grama (<i>Bouteloua gracilis</i>)	Bgr	2	25	40	2½	40	30	85	80
2.	Mountain muhly (<i>Muhlenbergia montana</i>)	Mmo	4	25	25-30	6	30	15-20	50	40
3.	Arizona fescue (<i>Festuca arizonica</i>)	Far	6	25	25	8	35	15	40	30
4.	Black grama (<i>B. eriopoda</i>)	Ber	2-3	20	50	3-4	35	30-35	70	60
5.	Side-oats grama (<i>B. curtipendula</i>)	Ben	4	30	35	6	30	30	75	50
6.	Curly mesquite (<i>Hilaria bolanderi</i>)	Hbo	1½	20	30	2	20	20-25	85	85
7.	Bluestem (<i>Agropyron smithii</i>)	Asm	3½	20	50	4½	25	40	75	60
8.	Kentucky bluegrass (<i>Poa pratensis</i>)	Apr	1½	15	?	2½	25	?	90	90
9.	Wolf tail (<i>Lycurus phleoides</i>)	Lph	2½	25	35	3	30	30	70	60
10.	Bullgrass or Deergrass (<i>M. emers- leyi</i> or <i>rigens</i>)	Mem- Mri	6	30	30	8	40	20	30	10
11.	Hairy grama (<i>B. hirsuta</i>)	Bhi	2	20	45	2½	40	30	85	80
12.	Squirrel tail (<i>Sitanion hystrix</i>)	Shy	4	25	40	5	35	30	40	30
13.	Black dropseed (<i>Sporobolus inter- ruptus</i>)	Sin	2	20	35	3	35	20	75	60
14.	Pine dropseed (<i>Blepharoneuron tri- cholepis</i>)	Btr	2½	25	50	3	30	40	35	25
15.	Tobosa (<i>H. mutica</i>)	Hmu	4	10	30	6	20	15	50	30

¹Listed in the order of their importance as utilization indicators on southwestern national forest ranges.

²Weight basis.

³Inter-agency Range Survey Committee Approved Palatability List.

Handling Livestock

Tobosa grass (*Hilaria nutica*) is an important source of feed and is found in nearly pure stands on approximately 5,300 acres of the Jornada Experimental Range. Experiments in cutting and feeding this grass for hay were conducted during 1937 and 1938, when 8 acres in 1937 yielded about 4 tons of hay and 33 acres in 1938 yielded 21 tons. The hay was cut and stacked near the cutting sites for future use at an average cost of \$4.71 per ton.

The Jornada cooperator began feeding 800 calves on November 15, 1938, not because of drought conditions but for the purpose of realizing a profit from the added weight gained by feeding concentrates. Several calves selected at random averaged 214 pounds in weight prior to supplemental feeding. One and one-fourth pounds of cottonseed cake were fed daily with tobosa hay as roughage or filler, and it was observed that the calves ate all the hay with considerable relish. On February 2, 1939, the calves were again weighed, and the average weight was 265 pounds or an average gain of 51 pounds per calf for the period. Further weighings after February 2 showed that the calves were still gaining steadily. The entire supply of the tobosa hay harvested during 1938 was consumed in this experimental feeding.

Tests made in the feed lot convinced the cooperator that calves actually prefer the tobosa hay to good alfalfa when fed as roughage with concentrates. Of course this is true only if the tobosa grass is harvested at the proper time so that it may be palatable. It is very economical as the average rancher may cut and stack this hay for less than \$4.00 per ton as compared with alfalfa hay which will cost \$11.00 per ton in normal years, not including the added cost of hauling to the feeding site.

It is believed that the most important value of this hay lies in its use during drought emergencies which are sure to come periodically in the Southwest. During such droughts, the demand will force the price of alfalfa hay as high as \$25.00 per ton and will make the feeding of a large number of cattle impracticable because of the cost.

Chemical analysis of this grass harvested at the proper time shows that it compared very favorably with good quality western prairie hay in protein and carbohydrates. The harvest must be accomplished as soon as possible after sufficient growth has been obtained but before the plants become woody. This stage of growth will vary according to the climatic conditions, as tobosa will invariably make a further growth after every rain. Since it will not pack down so closely as to ferment in the stack,

it is possible to stack or bale the hay very soon after cutting. The grass, if properly prepared has the characteristic fragrant hay odor and remains a bright green color all winter. This no doubt is a factor influencing the ready consumption of the feed by livestock.

COOPERATING BUREAU PROJECTS

ENTOMOLOGY

(In cooperation with the Bureau of Entomology and Plant Quarantine)

Appalachian

An autogiro was used for southern pine beetle survey work by Craighead and Wilford to test the adaptability of this type of machine for bark beetle spotting and control work. The preliminary test made on the Coastal Plain of North Carolina and Virginia was very encouraging. Lone bug trees were readily spotted from the giro at the low altitudes flown; the slow speeds and short radii on which the machine turned permitted thorough examination of individual trees.

Southern

With the cooperation of officials of the National Pest Control Association and at the request of the Reconditioning Division of H.O.L.C., suggestions were made for the revision of the Master Specifications dealing with the control of termites and powder-post beetles.

Christian, at Tallulah, is obtaining many living Lyctus adults emerging from wood in the constant temperature chamber, which are being placed in cans with chemically treated wood and in sealed jars with untreated wood of various moisture contents to determine ranges of moisture preference. On March 8, Major Ware and Mr. Christian, of the Chicago Mill and Lumber Company, Tallulah, consulted this office with regard to these tests. The tests at Vicksburg, Mississippi, have been dismantled and the infested lumber and 20-mesh copper screen will be used at Tallulah.

PATHOLOGY

(In cooperation with the Bureau of Plant Industry)

Appalachian

Decay Following Fire

The investigation of decay following fire in Appalachian oaks has been completed and the results prepared for publication. A statistical mechanism was developed by which the cull that follows a particular fire can be predicted. The predicting equation is for single trees and is based upon width of basal wounds 18 inches above ground and number of years since the fire. It could not be demonstrated that basal wounds of equal width produced significantly different amounts of cull among the various species of oak or among the different sites. Much of the variation in amount of cull among trees with wounds roughly the same in size and age was due to the different fungi that became established. Of the 16 species of decay fungi isolated from decay following wounding the most common were Stereum frustulosum and Hydnum erinaceus.

Effects of Timber Stand Improvement

A report on the effects of past timber stand improvement work on subsequent damage and disease of trees in all national forests (except one) in the Station's territory, was completed. This report was based upon the examination of treated areas. A few salient points from this report follow:

1. Twenty percent of the trees cut or girdled were eliminated for pathological reasons. Such trees were hollow or had serious basal wounds, conks, cankers or other serious defects.

2. After 5 years, more than 50 percent of the girdled fire cherry, yellow poplar, ironwood, hickory, dogwood, and magnolia had broken over. Less than 25 percent of the oaks, beech, black locust, and hemlock had broken. Combining all species 33 percent of the girdled trees had broken over.

3. Twenty-nine percent of the girdled trees that had broken over knocked down one or more desirable trees.

4. Thirty-nine percent of the climbing vines on desirable trees had not been cut, 24 percent had been cut and had not regenerated, 28 percent had been cut and had grown again to some extent, and 9 percent had been cut and had regenerated to the point where they were again causing damage.

5. It was apparent that, in general, a reasonable amount of attention had been given pathological factors, although considerable improvement is needed, particularly in knowing when and how to eliminate surplus sprouts of different ages.

Northeastern

Considerable attention has been given to the blue stain problem in salvaged timber in the hurricane area. T. C. Scheffer of the Forest Products Laboratory, who has had extensive experience with stain in the South and in practical treatments for its prevention, spent $2\frac{1}{2}$ weeks traversing the area, learning conditions and getting information at mills, veneer plants, etc., and advising timber owners and handlers. The Timber Salvage Administration has put into effect good stacking practices with the sawed lumber and expects to get the white pine logs into water or sawed into lumber about June 1. This, apparently, will eliminate the stain as a serious problem. Private owners showed too little interest to justify further action.

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